Distr.
GENERAL

UNCTAD/COM/82
27 March 1996

ENGLISH ONLY

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

THE DYNAMIC INTERRELATIONSHIP BETWEEN FINANCIAL MARKETS AND COMMODITY MARKETS

Dr. Theodosios B. Palaskas
International Development Centre
University of Oxford

The views expressed in this publication are those of the author and do not necessarily represent the views of the UNCTAD secretariat. The designations employed and the presentation of the material do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

GE.96-50856

CONTENTS

	Paragraphs
INTRODUCTION	1 - 9
I.1. Internationally traded commodities of interest to LDCs (Cocoa, coffee, sugar, rubber, cotton, copper)	10
I.2. Volatility in prices of commodities and manufactures . .	11 - 16
I.3. Speculation and the trading and growth of commodity futures	17 - 29
I.4. Portfolio capital flows	30 - 31
I.5. Seasonal factors, hedging, and macrovariables	32 - 38
I.6. Formation of market commodity prices with references to the pressure of demand on supply, speculation levels, expectations, and hedging	39 - 52
II.1. Testing for the Short-term and Long-term Interrelationship between Commodity Futures Prices and Futures Markets Activity	53 - 77
II.2. Examining the relationship between the futures/physical ratio and price instability	78 - 90
II.3. Co-movement and excess co-movement of commodity prices .	91 - 103
II.4. The effect of fundamentals (stocks) on recent commodity price behaviour	104 - 109
II.5. Commodity price instability and the instability of the earnings of commodity exporting countries	110 - 116
III. Conclusions	117 - 124
Appendix I	
Appendix II	
Appendix III	
References	
Tables	
Graphs	

INTRODUCTION

1. The sustained decline in commodity prices during the decade of the 1980s generated a substantial empirical literature about the factors determining the behaviour of market commodity prices.

2. The topic of interaction between commodity prices studied by Pindyck and Rotemberg (1990), Palaskas and Varangis (1991) and Maizels and Palaskas (1995), and the topic of interaction between commodity prices and macroeconomic policies of the industrialized countries studied by Frankel (1986), Beenstock (1988), Durand and Blondel (1988), Gilbert (1989), Gilbert and Palaskas (1989), Palaskas and Varangis (1989), Broughton (1991), Broughton and Branson (1991) and Trivedi and Varangis (1994) have been the most widely researched. The empirical evidence shows that a dynamic relationship exists between commodity prices and macroeconomics, running from the latter to the former, and that commodity prices co-move above and beyond that which can be explained by the movements in macrovariables.

3. In recent years, an explosion in the volume of transactions in financial instruments such as futures contracts, and contracts in derivatives (swaps, options, etc) appears to have been associated with greater short-term volatility in key financial markets, as expressed in terms of interest rates, share prices and exchange rates. The volume of speculative funds coming into, and out of, various asset markets, especially during the last two and a half years (Gilbert 1994), is now so large as to be frequently the predominant influence in the foreign exchange markets, largely displacing the underlying 'fundamentals' of changes in trade flows and in the terms of trade.

4. Traders of primary commodities are well aware of the important role that fund managers and market-makers play in the commodity futures. During the recent (July 95) coffee futures crisis there was a consensus among the traders at the coffee, sugar and cocoa exchange (CSCE) in New York, that the fund managers and market makers had profited handsomely at the expense of buyers and sellers of actual coffee, according to the Financial Times (July 10th, 1995). Profits for the funds have come from liquidating their long positions (selling futures they own) and taking up short positions (selling futures they did not own) as the price fell. With the funds therefore showing little inclination to support the price, it fell, first on technical grounds, then driven by what was thought to be the collapse of retention schemes. Even when the coffee futures price started recovering on the eleventh of July following the Latin American coffee producers' reduction of exports, traders were not sure whether the upwards momentum would be sustained because, as they have been quoted to have said, 'it all depends on how the funds and the speculators react to the news'.

5. At the same time, since the role of fund managers has increased significantly in commodity futures, there has been a general reversal in the decline of primary commodity prices, ensuring high returns to the funds which invested early in the process. Non-oil primary commodity prices rose sharply over the eighteen months to the end of 1994, in general from historically low levels. The coffee price in London was up over 200% in December 1994 with respect to its average level in June 1993. At the end of 1994 copper prices were 73% up on their end of 1993 level. More modest rises were seen in the prices of cocoa and sugar. The coincidence between the arrival of the commodity fund money and the increase

in commodity prices raises the question of whether the inflow of money from managed funds into traditional commodity markets has been partly responsible for the recent upward movement of commodity prices.

6. Another issue that is of great importance to commodity futures is the general belief that commodity funds increase the volatility of the markets on which they trade (Gilbert 1994). This seems to be supported by the empirical evidence presented by Labys and Thomas (1975) and most recently by Enis Kocagil (1993) which rejects the hypothesis that an increase in the intensity of futures speculation tends to decrease commodity price volatility, and thus, stabilizes spot markets.

7. The present study aims to quantify the short-term and long-term influences of financial market movements and instability, particularly that resulting from transactions in futures and derivatives contracts, on the behaviour and instability of international commodity prices. In addition, the role of the strengthening of fundamentals (shifts in supply and demand) in the upward movement of commodity prices in the last two years is examined.

8. The study is essentially econometric, using recent developments in time series, with separate analyses for each major commodity (cocoa, coffee, sugar, rubber, cotton and copper). Data for transactions in financial instruments in London and New York will be used to represent the speculative element in the financial and commodity markets. Corroboration of shifts in market fundamentals is obtained by looking at stock levels.

9. The study consists of three parts. In part I some background information is presented on the international commodity markets and the role of the speculative funds in commodity futures as well as the role of the fundamentals. More specifically, in section 1, the importance of internationally traded commodities of interest to LDCs is presented. Next, in section 2, the volatility in prices of commodities and manufactures is compared and the factors determining it are analysed. In section 3 the definition of speculation is described and its importance in futures in general, and in commodity futures of cocoa, coffee, sugar, rubber, cotton and copper, in particular, and on commodity funds is presented. In sections 4 and 5 the role of portfolio capital flows, and seasonal factors, hedging and macrovariables are examined respectively. Finally, in section 6 the formation of market commodity prices with reference to the pressure of demand on supply, speculation levels, expectations and hedging are presented. In Part II the econometric analysis is presented. In section 1 the short-term and long-term influences of financial markets on commodity future price of the six commodities under consideration in the London and New York commodity exchange markets are examined applying recent developments in the econometrics of time-series on daily data over the period March 1991 to February 1995. Also the degree to which commodity price variation is a cause of financial market instability and vice-versa is examined. In section 2 the relationship between speculation and price instability for the six commodities under consideration is examined using monthly series. Next in section 3 the hypothesis of co-movement and excess co-movement of commodity future price above and beyond that which can be explained by the financial future variables is examined. In section 4 the role of fundamentals in the recent behaviour of commodity prices is examined by looking at the relationship between prices and stocks. Section 5 consists of an analysis of the effects of commodity price instability on LDCs. Finally, part III summarises the conclusions of the study.

I.1. Internationally traded commodities of interest to LDCs (Cocoa, coffee, sugar, rubber, cotton, copper)

10. Primary commodities are of major importance to LDCs, since many of these countries depend to a very large extent on their exports of these products. In 1970, primary products (excluding fuels) accounted for nearly 70 per cent of the exports of (non-OPEC) LDCs. By 1980 the LDC share had fallen to 40 per cent, and by 1990 to 25 per cent. This fall reflected both the rise in volume and value of LDC oil exports (from 8 per cent of non-OPEC LDC exports in 1970 to 23 per cent in 1980, but down again to 9 per cent in 1990), and an increase in the share of manufactures in LDC exports (from 23 per cent in 1970 to 38 per cent in 1980 and 66 per cent in 1990 for non-OPEC LDCs). However, the bulk of LDC manufactured exports comes largely from a small number of relatively industrialized countries such as South Korea, Taiwan, Hong Kong, Brazil and Mexico. The majority of LDCs still remain heavily dependent on exports of primary products and fuels (34 per cent of all non-OPEC LDC exports in 1990). In terms of the commodities themselves, in 1990 non-OPEC LDCs accounted for only 24 per cent of all world primary product exports and only 17 per cent of all world fuel exports. Thus although trade in primary products is particularly important to the LDCs, that trade tends nevertheless to be dominated by the developed countries. However, this does not hold for most of the sixteen commodities included in UNCTAD's (1975) list of 'core commodities'. Shown in table I.1a are the percentage of world exports of six of these commodities originating from LDCs. Clearly, these internationally traded commodities are of great importance to LDCs.

I.2. Volatility in prices of commodities and manufactures

11. Variability of commodity market prices arises through the transmission of supply and demand disturbances (harvest fluctuations and fluctuations in aggregated demand in industrialized countries) to the market price. Relatively low short-term supply and demand elasticities can lead to sharp price fluctuations, although these will be moderated by private stockholding behaviour. This problem is often referred to as the instability of primary commodity prices. Volatility, however, might be a better description. Some low elasticities are for primary commodities are shown in table I.1b.

12. MacBean and Nguyen (1987) measure instability for a number of individual commodities by percentage deviations of annual averages from an exponential trend in the 1951-1980 period. Sugar, coffee and cocoa emerge as three of the most unstable commodities with deviations above 40 per cent. McNicol (1978), meanwhile, looks at prices in terms of highs, lows, the ratios between the two, and a coefficient of variation, for some of UNCTAD's 'core' commodities and some manufactures over the period 1951-1975. The coefficient of variation calculated is the ratio of the standard deviation of a series to its average. Some of the results are shown in table I.2.

13. The present study looks at the same information as McNicol (1978), but uses daily price series over the four year period 1991-1995 for commodities traded in London and New York. The results are in table I.3.

14. Evidently, the primary products have coefficients of variation between 0.22 and 0.61 using McNicol's figures for 1951-75 and between 0.14 and 0.65 using this study's figures for March 1991-February 1995. The comparable figures from

McNicol's study for manufactures are between 0.06 and 0.13. This suggests that the prices of commodities are subject to greater instability or volatility than those of manufactures.

15. Traditionally commodity prices are determined by the interaction of supply and demand. Unlike industrial products, often produced in oligopolistic markets, primary commodity markets are considered to be typically competitive. Thus the variability of commodity prices over time, relative to that of manufactures, is attributed to the variety of events which can cause supply and demand to change. These changes will tend to be larger when there is a heavy geographical concentration in the production or consumption of the commodity in question. Agricultural commodities experience harvest fluctuations. Strikes can sharply affect the supply of minerals. Political disturbances may cut the supplies of all types of commodities. Business cycles are known to cause variations in demand, especially for goods with high income elasticities. Demand shifts for some commodities might be due to inventory changes caused by speculative, commercial or political factors. Technological shifts, too, can sometimes change the demand for a commodity. International markets for agricultural commodities in particular often exhibit an especially high degree of volatility. This is evident in the high coefficients of variation presented above for cocoa, coffee and sugar which lie between 0.14 and 0.65. This occurs because the major industrialized countries often isolate their domestic markets through agricultural protection. The export supply of these countries, sometimes constituting a large share of the total international market, will be determined by national production and consumption, and will not be influenced by the international market price.

16. Low short-run price elasticities and considerable variability in demand and supply for many commodities provide an explanation for the observation that commodities experience a greater degree of price instability than do manufactured goods. This picture, however, may be quite misleading for those commodities which can be easily stored. In this case, production does not have to equal consumption, as the difference is met by net additions to stock. In the markets for industrial products, fluctuations in demand are typically matched by inventory changes, with production and consumption adjusting only slowly to changing market conditions. In commodity markets, producers, consumers, merchants and speculators all hold stocks. A decision to purchase a given quantity of the commodity today, and to sell it in three month's time, will tend to raise today's price and lower the price three months later. Decisions to buy or sell the commodity for stock therefore link prices over time. Gilbert and Palaskas (1989) recognize that such a storage factor is at least potentially important in these markets. Only if no stock is carried can the two temporally separated markets be independent. Anticipations of future outcomes indirectly affect present prices through stockholding; intertemporal prices generated by the market support an intertemporal stockholding pattern. Prices and stocks are therefore complementary, and the relationship of commodity prices over time might be determined by the circumstances in which market agents will be willing to hold certain sequences of stocks, resulting from differences between production and consumption, which are themselves dependent on price sequences. The question of whether such stockholding stabilizes commodity prices, however, has long been subject to debate, and requires investigation of the role of speculation, which this paper undertakes in section 6.

I.3. Speculation and the trading and growth of commodity futures

17. Speculation is the action taken by traders whose objective is to make profits by successfully anticipating future price movements. Speculators buy and sell futures contracts with the expectation of profiting from changes in the price of the commodity in question. Two views of such speculation have arisen in economic literature. One is that which underlies Hirshleifer's (1975) definition of speculation, and is put most succinctly by Harrison and Kreps (1978) who define investors as exhibiting speculative behaviour 'if the right to resell a stock makes them willing to pay more for it than they would pay if they were obliged to hold it for ever'. This implies that speculation results largely from divergent views with regard to future outcomes. The other view defines a position as speculative to the extent that it is uncertain, and a speculator as an agent who maintains an uncovered position. This view implies that speculation results in the transfer of risk from agents with high risk aversion, or who are unable to diversify their positions, to agents with low risk aversion, or who can more easily diversify their positions. The former group is identified as 'hedgers' and the latter as 'speculators'.

18. Speculation as a risk transfer is important as it reduces the risk premium (the difference between the expected cash price and the prevailing futures price) embedded in futures prices, and, as a consequence, reduces the cost of hedging (the offsetting of price risk through futures contracts). The existence of futures markets makes stockholding a relatively riskless activity and financial institutions will generally be happy to take this on, buying on the cash market and selling on the futures market. Towards maturity of the futures contract, they can either roll this position forward, or they can sell their stock and close their futures position by making an offsetting futures purchase. The existence of futures markets therefore allows the distinct activities of stockholding and speculation to be separated. In addition futures prices become better approximations of expected cash prices. More speculation makes futures markets more efficient at performing their hedging and price discovery (the establishment of equilibrium futures prices) functions. On the other hand,speculation is often criticised on the grounds that speculators do not trade on the basis of economic fundamentals, but in reality respond to 'mob psychology', driving prices irrationally in one direction and then in the other. The result, it is argued, is increased price volatility, which arguably leads to higher risk premiums and less efficient prices.

19. The volume of speculative trading in futures markets is substantial. Some available statistics are those produced by the Commodity Futures Trading Commission (CFTC), and they suggest that speculation constitutes more than half of the total trading volume. For example, given data on the monthly mean speculation as a percentage of open interest (futures or options contracts not yet offset by opposite futures or options transactions, or fulfilled by delivery of the commodity, or by exercise of the option), for 1989 from the Chicago Board of Trade, it appears that speculative trading constituted 54.1 per cent of the total open interest for soyabeans, 47.9 per cent of that for corn, 51.9 per cent of that for wheat, and 53.5 per cent of that for oats, for example. Moreover, the data used in this study also suggest a huge volume of speculative trading in the futures markets. This is evident in the calculated ratios of futures to physical trade which help identify the amount of excess speculation. The ratios calculated for the 1990s indicate that in all cases studies there exists at least 3 times as much futures trade as physical trade, and thus a great deal of excess

speculation. In some cases (US sugar futures) there exists as much as 100 times more futures trade than physical trade, and thus a huge volume of speculative trading.

20. In the last thirty years dramatic changes have been observed in the futures markets. In 1960 four million futures contracts changed hands during the year on all futures exchanges in the United States. Twenty years later the number of futures contacts increased to almost 100 million and jumped to nearly 280 million in 1990.

21. The composition of the commodities that were traded in 1960 compared to those that are traded today has also changed dramatically. In the sixties most of the futures contracts were in agricultural commodities and dominated by eggs (no longer traded), wheat, potatoes (no longer traded), soyabean (oil and meal), oats and copper. Today more than half of all futures trading is in financial instruments, such as bonds, foreign currencies and stocks.

22. With respect to the agricultural futures under consideration in the US in 1990, **sugar** #11 accounted for 11%, **coffee** 'c' for 3%, **cocoa** for 2.9% and **cotton** for 2.7% of the total trading volume of agricultural and soft commodities. Of the commodities not to be examined here, corn accounted for 20%, soyabean (meal and oil) for 36% and other commodities such as wheat, live cattle, and live hogs etc. for the other 24%. Outside the US raw **sugar** is the most active future contract. It accounted for 2.7% of trade on the London FOX in 1990. Overall, raw **sugar** contracts accounted for more than one third of the trading volume of agricultural and soft futures outside the US. **Rubber** is traded mainly in Japan and was the second most actively traded agricultural commodity in futures markets outside the US in 1990 after raw **sugar**, accounting for 11.3% of the total trading volume of agricultural and soft commodities (7% in Tokyo and 4.3% in Kobe, 1990). **Cotton** is also heavily traded and accounted for 9.4% of the total trading volume of agricultural and soft commodities outside the US in 1990. **Cocoa** and **coffee** are heavily traded on the London FOX and accounted for, in 1990, 5.2% and 3.6% respectively of the total trading volume of agricultural and soft commodities outside US futures markets. With respect to industrial metals futures, the volume of trade on US exchanges is relatively small. The London Metal Exchange (LME) dominates world trade in industrial metal. The only active industrial metal future in the US is the commodity exchange's **copper** contract. However, the trading volume in **copper** is higher on the LME. **Copper** is the most heavily traded industrial metal on the LME accounting for about 45% of the total annual trading volume in 1990 of major industrial metal futures contracts.[1]

23. During the 1990s the following situation has prevailed for each of the commodities under consideration. **Cocoa** futures have continued to be traded more widely in New York than in London. In 1993/94 9.6 times as much cocoa nearest future volume was traded in New York as in London. In both markets the ratio of futures to physical (F/P) trade has risen with the volume of futures traded. Between 1991/92 and 1992/93 the nearest future volume in London rose by 5.4% from 2764.1 thousand to 2912.3 thousand tonnes, whilst the F/P ratio rose by 2.2% from 14.92 to 18.17. At the same time the nearest future volume in New York rose by

---

[1] The figures quoted here for percentage share of markets appear in Edwards and Ma (1992).

34.7% whilst the F/P ratio rose by 34.6% from 34.66 to 46.65. This confirms the view that the New York market has always been seen as the more speculative of the two cocoa markets.

24. **Coffee** futures have also continued to be most widely traded in New York. In 1993/94 they were 52.2 times more widely traded in New York than in London. In London both the futures volume and futures to physical ratio rose between 1991/92 and 1992/93, yet remained roughly stable between 1992/93 and 1993/94. In New York, however, both volume and F/P ratio have steadily risen in the 1990s. Overall, between 1991/92 and 1993/94 the volume of nearest futures in London rose by 49.6% from 599.2 thousand to 896.4 thousand tonnes whilst the F/P ratio rose by 26.5% from 3.4 to 4.3. Meanwhile, in New York the nearest future volume rose by 38.8% from 33732.7 thousand to 46823 thousand tonnes whilst the F/P ratio rose by 89.1% from 24.7 to 46. The results suggest again that the New York market is the more speculative of the two coffee markets.

25. **Sugar** futures continue to be very heavily traded in the 1990s especially in the US, where the ratio of futures to physical trade is very high (119.04 in 1993) and where both the volume traded and this ratio have risen steadily, by 23.5% and 38.9% respectively between 1991 and 1993. In London trade rose much (57.7%) between 1991 and 1992 but fell between 1992 and 1993. The futures to physical ratio roughly followed this pattern, rising by 28.4% between 1991 and 1992 but only by 1.3% the year after. Still in 1993 there remained 26.9 times as much sugar futures activity in New York as in London.

26. With respect to **rubber** futures, trade has increased hugely in the 1990s in Kobe along with the futures to physical ratio. Between 1992 and 1994 the volume traded increased by 270.5% from 3959.7 thousand to 14669.4 thousand tonnes whilst the ratio rose by 288.6% from 5.86 to 22.77.

27. **Cotton** futures have also continued to be heavily traded in the US. The volume especially increased (by 27.9%) along with the futures to physical ratio (which increased by 14%) between 1992/3 and 1993/4.

28. **Copper** futures have also continued to be heavily traded in the 1990s. The volume traded in London rose by 139% between 1992 and 1994, whilst the UK futures to physical ratio rose by 97%. The volume traded in New York also rose, by 65% between 1992 and 1994. However, at the same time, the futures to physical ratio remained roughly stable, increasing by only 1.3%. In 1994, 13.8 times as much copper was traded in futures in London as in New York.

29. The changing nature of futures meant new types of market participants. Today the largest and most prestigious financial institutions such as banks, pension funds, insurance and investment companies and university endowment funds, use futures.

I.4. Portfolio capital flows

30. A distinction is often made between short-term and long-term capital flows. The former are categorised as unstable 'hot' money, and the latter as stable 'cold' money. Short-term capital flows are deemed speculative and reversible and long-term capital flows are seen to be based on fundamentals and are deemed reversible only when the fundamentals change. Many observers such as Reisen (1993), Nunnenkamp (1993), and Turner (1991) argue that recent flows with short

maturities are inherently unstable. However, using time-series analysis of data for five industrial and five developing countries, Claessens, Dooley, and Warner (1995) observe that in most cases the labels 'short-term' and 'long-term' do not provide any information about the time-series properties of capital flows. If only time-series statistics are available, they argue, it would not be likely that the label of the flow could be determined. Furthermore, long-term flows are seen to be often as volatile as short-term flows, and the time it takes for an unexpected shock to a flow to die out is shown to be similar across flows. Moreover, short-term flows appear to be at least as predictable as long term flows. There is little evidence that information about the composition of flows is useful in forecasting the overall level of flows.

31. The implication of these observations is that there is too great an emphasis on analysing specific flows, especially short-term portfolio flows. Virtually no time-series property can be regarded as an inherent property of any particular kind of flow. Any attempt to reduce capital account volatility by administration limiting short-term flows is unlikely to be effective because there is shown by Claessens, Dooley and Warner (1995) to be little evidence that these flows are in reality more volatile than other flows. On the basis of this work,therefore, it would seem that speculative flows should not be considered as causing any more volatility than any other capital flows.

I.5. Seasonal factors, hedging, and macrovariables

32. It has already been stated that the supply of a primary commodity might vary due to harvest fluctuations. However, given that many of the 'core' primary commodities are agricultural products, there will also obviously be seasonal fluctuations in supply due to the timing of the harvest. This could have a significant effect on international commodity prices.

33. Moreover, given that the year's production of a certain commodity for a producer might be produced exclusively at one time or season (or more) in the year, but might be purchased and consumed throughout the year, the producer (or wholesaler or processor of the commodity who might acquire the whole inventory at once) will be placed at some risk with respect to changes in the price of the commodity in the future, after the harvest or time of production (or time of acquisition of the inventory). Even without the presence of seasonal production, owners of commodity stocks might find themselves in this position. Hedging provides a solution to this situation. The general principle of hedging is to open a futures position opposite to that anticipated in the cash market position.

34. A hedger may firstly safeguard against the risk that the value of unsold products will decline if the commodity price falls. An owner of commodity stocks who is not interested in price speculation, can insure himself against this risk by making a short hedge at the time he acquires his inventory, i.e. by futures sales involving quantities and due dates that correspond to the planned disposal of his physical inventory. In this way he insures himself of the current commodity price for these future disposals. Each time he makes a physical disposal, the owner will buy a corresponding amount spot on the exchange. The initial futures and later spot transactions on the exchange will cancel out each other. If the price has fallen in the period between physical acquisition and disposal, there will be a loss from the physical transactions, but a compensating gain from the futures purchase and spot sale on the exchange. If the price has risen, the exchange transactions loss will be compensated by the gain in the

physical trade. The cost of this hedge will be the interest on the margin payment, the brokerage fee plus any contango (due to the existence of a market in which futures prices are higher for distant contracts than for nearby delivery months), or minus any backwardation (due to the existence of a market in which the futures prices of distant contract months are lower than those of the nearby contract months) that prevails in the market at the time that the futures contract is agreed. Commodity producers often make short hedges when they consider the current price attractive.

35. Secondly, a hedger may insure against the cost of future commodity purchases increasing if the commodity price rises. When a commodity user believes that the current price is attractive, or when he tenders for manufactured deliveries with a high content of the commodity several years into the future, he might find it advantageous and prudent to lock in the current price for his future purchase needs. He can do this through a long hedge, purchasing futures timed to coincide with his future physical commodity needs. The future contracts can be cancelled out by spot sales on the exchange at the time of the physical purchases.

36. The possibility of hedging a specific commodity is not entirely contingent on it having a developed futures market. An incomplete, but often satisfactory hedge can be attained with the help of a closely related commodity whose price is likely to move in parallel with one on which the hedger is dependent.

37. With respect to macrovariables, Palaskas and Varangis (1989) found that the interest rate plays an important role in both the short-run and long-run determination of non-fuel primary commodity prices. It was concluded that the hypothesis that there is a stationary long-run relationship between the levels of commodity prices and interest rates cannot be rejected. Such conclusions are in accordance with the theory of commodities as financial assets and contrast with Powell's (1989) findings that interest rates play little role in either the short-run or the long-run. Moreover, the introduction of the price of oil as a macroeconomic variable was found to have a significant impact in explaining the variation of commodity prices. Although a stationary long-run relationship was not established between commodity price indices and money supply movements, causality was established running from fluctuations in the money supply to fluctuations in commodity price indices. Movements in commodity price indices were also found to cause movements in consumer price indices of major OECD countries. Labys, Thomas and Gijsbers (1986) moreover conclude that there are many situations in which the importance of monetary and economic influences on short-run commodity price behaviour is confirmed. Such influences include effective exchange rates and treasury bill rates.

38. The present study has also found some evidence for a long-run stationary relationship between commodity (nearest future) prices and certain macrovariables using a cointegration methodology. The logarithms of the commodity price series and financial series described in appendix I were found to be non-stationary[4]

---

[4] A variable whose average value (mean) and whose variance (average fluctuations about the mean) are not constant and time is defined as being "non-stationary". If taking the first difference of the variable makes it stationary, the variable is "I(1)".

(all I(1)), yet cointegration tests[1] showed that in some cases a long-run stationary relationship could not be rejected. Without presentation of all the results, it should be noted that the methodology presented by Kwiatowski et al. (1992) was used on daily data and pointed to cointegration between some pairs of commodity prices and financial series. This was particularly the case for the eurodollar futures and US 3-month treasury bill futures which are cointegrated with all the commodity price series in question except for those for copper which appear to be cointegrated with short 3-month sterling futures and US 30-year treasury bond futures. In addition, the commodity price series for sugar in New York and rubber in Kobe appear to be especially cointegrated with many financial series. Further tests using weekly and monthly series constructed from the daily data, and augmented Dickey-Fuller tests provided less positive results, and established no pattern. Nevertheless, such tests for stationary long-run relationships between macrovariables and commodity prices clearly continue to provide support for the existence of a role for certain macrovariables in the determination of primary commodity prices.

I.6. Formation of market commodity prices with reference to the pressure of demand on supply, speculation levels, expectations, and hedging

39. As in all other markets, the basic forces determining price in an international commodity market are supply and demand. The demand schedule for commodities is ordinarily steeply downward sloping, whilst the supply schedule typically slopes gently upwards until the level of full capacity utilization, where it becomes vertical. Prices might rise with a shift in demand which might be caused, for example, by economic growth, by an upturn in business conditions, increasing demand for current consumption as well as for user inventories, or by expectations, rational or irrational, of an impending price increase, which result in a surge in inventory demand for speculative purposes. Prices might also rise due to a fall in supply which might be a consequence of a disruption immobilizing producers, such as crop failure due to disease or weather, a strike, or a political upheaval that arrests exports. It might be noted that the higher is the initial capacity utilization, the greater will be the price impact of given shifts in the demand or supply schedules. However, international commodity markets sometimes contain monopolistic features which result in prices different from those expected to prevail under competitive conditions. When sellers have some monopoly control over the market, they will reduce supply and thus increase the price. When the buyers have some monopsony control over the market, they will reduce demand, and thus lower the price. When there are monopolistic elements among both sellers and buyers, prices might rise or fall depending on relative bargaining strengths. Furthermore, more complex price determination processes are involved when production results in the output of more than one commodity (as is the case with the extraction of polymetallic ores).

40. With respect to individual commodities, the collapse of the price-stabilizing mechanisms of the international coffee and cocoa agreements has been a major factor precipitating the sharp downward trend in prices for coffee and cocoa.

---

[1] If two 3(1) variables can be linearly related so that the result is stationary (I(0)), then there will be no tendency for the two variables to drift apart over time - they will follow more-or-less parallel time paths. In this sense, there is a stationary long-run relationship between them.

41. The cocoa market has also been characterised by substantial stocks resulting in the collapse of prices in both real and nominal terms. The impact on the market of persistent overproduction over the period 1984/5 to 1990/1 when annual production rose by 4.6 per cent, but consumption only by 3.7 per cent, has been negative on the cocoa price, despite a production fall until July 1993 when the recent upturn commenced. For the calendar year 1992, average cocoa prices were the lowest in nominal terms since 1972 and the lowest in real terms since the middle of the 19th century. In real terms the cocoa price remains low.

42. A high level of production of coffee and a rather modest increase in consumption combined with the lapse of the intervention clauses of the third international agreement in 1989 caused prices to reach in August 1992 their historically lowest level ever recorded in real terms, and one of the lowest in nominal terms. The 1992 and 1993 (up to the first quarter) prices of coffee were widely believed to be below the normal variable costs for a large number of coffee growers. The low price encouraged the producing countries to negotiate an export retention scheme, which was agreed in September 1993, by which twenty per cent of exports would be channelled into stocks as long as the coffee price was below a set level. The implementation of the new policy led to an increase in the coffee price.

43. Following a big decline in 1991, the sugar price slightly recovered in 1992. In early 1993 the price started upturning to return to the 1992 level in the summer of 1993. Since then various factors on the supply side, such as lower production in the 1993/4 crop year and the larger import demand from countries of the former Soviet Union, helped prop up prices (see Graphs 1a and 1b).

44. In the natural rubber market, supply and demand have been relatively steady. A factor that has contributed to relative stability has been the broader geographical spread of the tyre production industry in the last ten years reducing the impact of big rubber consumers on price. However, the ample production in relation to demand kept prices low for most of the period 1990-93. The reverse movement in the rubber price in January 1994 coincided with the drop in stocks from 71.3 thousand tonnes in December 1993 to 65.9 thousand tonnes in January 1994. The fall in the stocks and the rise in the price continued for the rest of the sample used in this paper (see Graph 2).

45. The cotton market is characterised by variations in supply and stable demand. The price has been generally determined by the supply variations. Estimates, for example, that cotton production in the 1992/93 crop year would be 11 per cent lower than in the previous year (the ample production led to a very low price) led to a slight recovery in prices. The effect of supply variations, as they are reflected in the changes of stocks, on the cotton price in New York is evident in Graph 3.

46. Since 1990 copper prices have been gradually declining, mainly affected by the slowdown of economic activity in the major industrialised countries and an increase in production. The heavy selling of copper by several suppliers of the former USSR countries and China combined with the weak demand, pushed the price in 1993 to a five year low. In the same period stocks increased hugely. However, low interest rates during 1992 and 1993 succeeded in generating an expansion in economic activity and higher levels of industrial production (OECD industrial production rose by 4.4% between 1993 and 1994). Consumption of copper was 7.8% up in 1994 compared to its 1993 level, whilst copper production fell

by 2.1%. The combination of those factors is reflected in the sharp drop of UK stocks from September 1993 (111.2 thousand tonnes) to March 1994 (86.6 thousand tonnes) to January 1995 (37 thousand tonnes). In the same period the price started rising gradually on the LME from a low of £1653.17 per tonne in November 1993 to £1929.37 per tonne in March 1994 to a new level of £3007.52 per tonne in February 1995. Similar movements took place in the US market. The stocks dropped from 88 thousand tonnes in May 1994 to 35 thousand tonnes in March 1995. The price rose from 74.13 cents per lb. in November 1993 to 89.77 cents per lb. in March 1994 and to 138.10 cents in January 1995. (See Graph 4).

47. With respect to speculation and price formation, there has been a long debate as to whether intertemporal stockholding (interpreted as speculation) has stabilizing or destabilizing effects. Friedman (1953) argued that in general speculation must be net stabilizing since, on average, stabilizing speculation will be profitable, and destabilizing speculation unprofitable. Speculators who are more often wrong than right will tend to lose money and will exit from the market. However, Hart (1977) showed that profitable speculation need not generally be stabilizing, whilst Baumol (1957), Kemp (1963), and others have analysed examples of speculation which is both profitable and destabilizing. Farrell (1966), nevertheless, showed that, given certain assumptions, a single profitable speculation is always stabilizing, but that a single unprofitable speculation is not necessarily stabilizing. However, he was unable to say anything about a set of speculative transactions. Ghosh, Gilbert and Hughes Hallett (1987), however, introduce competitive stockholding to a competitive storage function to conclude that competitive stockholding is necessarily stabilizing in an expectational sense, although in particular instances stockholding may take the realized price in the wrong direction. Theoretical work has thus largely been inconclusive.

48. In terms of expectations, under the Hirschliefer definition, if all agents are rational and have access to the same information and share the same prior beliefs, no speculation will take place. Under rationality, the willingness to speculate implies access to information and thereby communicates the price implications of that information to other market agents. On the other hand, differences in prior beliefs (Harrison and Kreps) will permit rational speculation. Such differences in belief clearly underlie much commodity market and stock market activity.

49. Considering hedging, and the risk premium involved therein, it is apparent that market price formation due to speculative behaviour does reduce this risk premium. Indeed, without any speculation, the net hedging imbalance would probably be so great that the size of the risk premium would be prohibitive, eliminating the markets entirely. The new demand schedule created by the introduction of speculators raises the futures price, and thus in reducing the difference between the futures price and the expected spot price, it reduces the risk premium for hedgers. In addition futures prices become better approximations of expected spot prices. Furthermore, the greater the amount of speculation, the lower the risk premium.

50. The limiting proposition that as the number of speculators becomes large relative to the number of hedgers, so that the net balance of hedging ceases to be relevant may be seen as the Efficient Markets Hypothesis (EMH). This proposition is a straightforward application of the zero profits condition of competitive markets to assets markets. The EMH states that speculation will

ensure that the futures price will be equal to the expected price for the date concerned. This may be regarded as realistic in commodity markets in which the total value of world trade is small in relation to potentially available speculative funds, but is less realistic in relation to currency and precious metals markets. The view of the EMH as a limiting proposition implies that, in practice, the return to speculation will be very low, but not zero. This efficient markets account of speculation, which has been criticised by Grossman (1977) and Grossman and Stiglitz (1980), has the implication that speculation imposes an efficient markets rational expectations structure on the expected price path. Market efficiency is the consequence of futures market liquidity and implies a common market expectation for future spot prices, that futures prices are arbitraged to those expected spot prices, and that there is a separation between stockholding and the assumption of price risk.

51. However, the question may still arise as to whether the activities of professional speculators are net stabilizing. The answer may be negative if there is a distinction between uninformed and informed speculators. If the uninformed speculators act on misinformation, then the informed speculators will take into account these activities in making their trades. If the market is invaded for a short time by large numbers of uninformed speculators, informed speculators will make money at their expense confident in the belief that they will make money on the way up and the way down. This can give rise to a brief 'speculative bubble'. Once uninformed speculation ceases, however, the informed speculators burst the bubble. Moreover, there also exists the problem of a 'rational bubble' in which speculators will be willing to hold a commodity for current capital gains (in the near future) even though they would expect continued holding to result in eventual capital loss. Undoubtedly, commodity markets do exhibit bubble episodes now and again, and this might put the efficiency of markets into doubt.

52. With respect to commodity prices, attempts, as discussed above, such as that of Baumol (1957) and Telser (1958) have been made to derive theoretical arguments regarding price stability. Conclusions, however, have proven contradictory suggesting that the problem can best be tackled on empirical grounds. Labys and Thomas (1975) confirmed a relationship between speculation and commodity price instability in this manner, using correlation analysis, and noting that traditional theory, stating that futures markets are normally in equilibrium, and that speculation and hedging help reduce price fluctuations due to supply and demand irregularities, is valid only when speculative demand or supply represent only a small proportion of physical demand or supply. They also provided evidence, also using correlation techniques, to support a relationship, based on the idea of portfolio management, between commodity prices and underlying economic and monetary influences.

II.1. Testing for the Short-term and Long-term Interrelationship between Commodity Futures Prices and Futures Markets Activity

53. In order to test the interrelationship between commodity futures prices and futures markets activity this paper follows a methodology which makes use of cointegration techniques. This is justified by the fact that it allows us to look at and analyse the relationship in both the long and short run.

54. Cointegration requires a long-run relationship between two variables after transient effects from all other variables have disappeared. The part of the response of one variables to another that never decays to zero is the steady-

state response, whilst the part that decays to zero in the long-run is the transient response. Thus short-run adjustment components are distinguished from long-run components in market commodity price relationships.

55. With respect to the interrelationship between commodity futures prices and futures markets activity, cointegration indicates that whilst the relationship may move away from its long-run equilibrium in the short run, due, for example, to the overshooting of prices, it will always return to its equilibrium in the long-run, due, for example, to market forces. Frankel (1986) and others have shown how commodity markets react in the short run to expectations concerning macro-economic disturbances. Frankel (1986) formalized the effects of monetary disturbances on commodity prices by extending the Dornbusch (1976) overshooting model of exchange rates. He showed that if changes in the real interest rates cause real commodity prices to overshoot in the short-run, they can still have a fixed or stationary relationship over the long-run. Such a long-run relationship may be ensured by the actions of traders which eventually return the relationship to equilibrium.

56. A necessary pre-condition for applying tests for cointegration is that the pairs of series in question are non-stationary in levels but are integrated of the same order, i.e they become stationary at first or subsequent differences. This is equivalent to testing whether there are unit roots in the stochastic generating process of the series. The presence of a unit root in the generating process suggests that the price series have to be modelled as difference stationary, i.e. integrated of order 1.

57. The daily future price series and the daily volume of contracts (which is used for futures markets activity) series of cocoa, coffee, sugar, cotton, copper and rubber (monthly data) were tested[4] for integration using Augmented Dickey Fuller (ADF) tests (1979), running the regression

$$\Delta Y_t = \alpha_0 + \beta_0 Y_{t-1} + \Sigma^n_{k=1} \beta_k \Delta Y_{t-k} + \epsilon_t \quad (1),$$

where Y was the series being tested for stationarity. The test is equivalent to testing whether $\beta=0$ using the DF critical values. The null hypothesis of the series being I(1), H_0:I(1),is rejected if the ADF-statistic is lower than -2.93(95%) or lower than -3.75(99%). The test regressions (eq.1) included lags of ΔY in order to remove serial correlation up to the order n=5, as detected by the Breusch and Pagan (1980) Lagrange Multiplier (LM) statistic. The unit root tests on the price and volume of the six commodities, reported in table II.1, are unambiguous. All the series were found to be I(1), that is, non-stationary in levels but stationary in first difference. Although non-stationary, the fact that these variables are I(1) makes them suitable for inclusion in the cointegration tests.

58. Next it was tested whether the nearest future price P_{ijt}, where i= cocoa, coffee, sugar, cotton, copper and rubber in market j, where j=London market (L) and New York market (NY) are cointegrated with their nearest future volume of contracts Q_{ijt} in London and New York markets respectively. It was also tested

---

[4] For a note on the notation of the variables used see appendix I at the end of this paper.

whether the volume of transactions in the London market, $Q_{1,t}$, is cointegrated with the commodity future prices in the New York (NY) market, $P_{NY,t}$, and whether the New York $Q_{NY,t}$ is cointegrated with the London $P_{1,t}$.

59. The test is equivalent to testing whether the linear combination ($Z_{1,t}$) of the regression

$$P_{1,t} = kQ_{1,t} + Z_{1,t} \qquad (2)$$

is stationary, i.e. $Z_{1,t} \sim I(0)$.

60. The results of the cointegrating regressions are reported in table II.2. Both the point estimates of the cointegrating parameter in the pairs of regressions, which would provide a band for the true value, and the asymptotic standard errors are reported. The ADF test statistic for a unit root in the residuals from these pairs of regressions strongly suggests that there is cointegration not only between the daily commodity near future prices and volumes in the London and New York markets respectively, but also across markets. This is indicative of a long-run relationship between commodity futures prices and futures market activity within and across these markets, even though the relationship might move away from equilibrium in the short run.

61. One of the theoretical implications of cointegration (Granger (1986)) is that since the two series $P_{1,t}$ and $Q_{1,t}$ are I(1) and cointegrated, there must be Granger causality in at least one direction, as one variable can help forecast the other.

62. Having established that the pair of $P_{1,t}$ and $Q_{1,t}$ are cointegrated in their own market and across markets, testing then examined both the direction of causality between the two series, and their exogeneity with respect to each other.

63. Such concepts are linked. Hendry (1995) presents a definition of strong exogeneity which is conditional upon firstly weak exogeneity, and secondly non-causality (non-Granger causality). This paper firstly tests for Granger causality between the price and volume series, and then also tests for weak exogeneity to attempt to confirm the 'causing' variable as exogenous.

64. The estimated F statistic results indicating whether $Q_{1,t}$ causes $P_{1,t}$ and vice versa are presented in the fourth and fifth columns respectively of table II.3a. The number of lags involved in each regression together with the degrees of freedom are also presented. Table II.3b presents t-statistics testing for weak exogeneity according to a t-test presented in Hendry (1995). The samples used correspond to those indicated in table II.3a.

65. The causality results within and across markets suggest uniformly that, for the sample period under consideration, it is the price that causes the volume of transactions and not vice versa. The combined results of weak exogeneity and causality strongly imply that the price is strongly exogenous and the volume endogenous. This in turn suggests that there exists a "bandwagon" effect: the clearer the price trend, the more speculators enter the market.

66. The results in table II.3b clearly confirm the causality results. It appears that in each case it is the price series which is weakly exogenous with

respect to the volume series (in combination with the non-causality of price by volume this represents strong exogeneity). This serves to confirm the view that it is the price that causes the volume.

67. In the presence of cointegration the relationships between the pairs of series can be expressed in the form of an error correction model

$$\Delta Y_t = \alpha + \beta Z_{t-s} + \alpha_1 \Delta X_t + \Sigma^{n}_{k=1} \delta_k \Delta Y_{t-k} + \Sigma^{n}_{k=1} \delta_k \Delta X_{t-k} + U_t \qquad (3)$$

where Z_t is the residual from the cointegrated regression. The significant β coefficient in each case indicates the dynamic adjustment of the variables in question to the error correction equilibrium. The closer to -1 this coefficient the quicker the adjustment of the error correction term Z_t to the long-run equilibrium path. The length of the lag of the term Z_t is presented by the figure S, the time period required for the dependent variable to start adjusting to the error correction term. The higher this figure the longer it takes for adjustment to begin i.e. adjustment takes place in the present period according to the disequilibrium in a past period, S periods earlier.

68. The results of the error correction regression are presented in table II.4 for the error correction model

$$\Delta P_t = \alpha + \beta Z_{t-s} + \alpha_1 \Delta Q_t + \Sigma^{n}_{k=1} \delta_k \Delta P_{t-k} + \Sigma^{n}_{k=1} \delta_k \Delta Q_{t-k} + U_t$$

The third column (S) gives the number of lags in days required for the error term to start causing the short-term changes in the dependent variable, or nearest futures prices. The value of S was determined by using the general to specific approach to establish which lag length was significant, or most significant, as an explanator of short-term changes in the dependent variable. The term $\alpha_1 \Delta Q_{1,t}$ accounts for the immediate effect, within a day, of a change in $Q_{1,t}$ on $P_{1,t}$. Note that BP in this table indicates a Breusch-Pagan statistic testing for autocorrelation. The order of autocorrelation considered is given brackets, and is usually three.

69. The results indicate that in many cases the relationship both within and across markets takes more than one day, and in some instances over a week, to respond to disequilibrium. The relationship between price and volume is not necessarily adjusted to its long-run equilibrium as the result of the actions of traders within one period (day). Adjustment takes place according to disequilibrium a number of periods before. This number appears to be the highest when the relationship in question concerns the volume of cocoa in London, the volume of coffee in New York, or the price in New York and volume in London of copper. The results also show, through the significantly negative β coefficients, that there is significant adjustment to the long-run equilibrium relationship in every case. This, in general appears to be quicker in cases concerning the nearest futures volume in New York, than in the cases concerning the nearest futures volume in London. The fact that there are only two significant α_1 coefficients indicates that in general there is little immediate response of changes in one series to changes in the other. The exceptions appear to be the cases of cocoa price in London with cocoa volume in New York, and sugar price and volume in New York. The overall response to changes in the commodity markets in question therefore can not be described as instantaneous. The insignificance of the autocorrelation test statistics serves to indicate the correct nature of the specifications used and the validity of the tests on the coefficients.

70. It might be useful also to examine another important property of the adjustment taking place between commodity nearest future price and volume. In addition to the standard error correction representation, the results of tests on an additional, asymmetric ECM are presented in table II.5. This model can be expressed as below

$$\Delta P_{t} = \alpha_{0} + \beta_{1} Zmax_{t-1} + \beta_{2} Zmin_{t-1} + \alpha_{11} \Delta Qmax_{t-1} + \alpha_{12} \Delta Qmin_{t-1} + \Sigma^{n}_{i=1} \delta_{1i} \Delta P_{t-i} + \Sigma^{n}_{i=1} \delta_{2i} \Delta Q_{t-i} + U_{t} \quad (4)$$

where Zmax is the value of Z if it is above the average of Z and the value of the average of Z otherwise, and where Zmin is the value of Z if it is below the average of Z and the value of the average of Z otherwise.

71. Testing the asymmetrical nature of the ECM terms can be performed by testing $\beta_1=\beta_2$ (or $\beta_1-\beta_2=0$) for the error correction term itself, and by testing $\alpha_{11}=\alpha_{12}$ (or $\alpha_{11}-\alpha_{12}=0$) for the immediate effect. Such testing can be undertaken to ascertain whether there is any significant difference in the symmetry of adjustment. That is, whether adjustment takes place at a quicker rate when the short-term disturbance is above or below its long-run mean level.

72. From these results it is evident that the hypothesis $\beta_1=\beta_2$ can be rejected in five of the eighteen cases in question. It can be rejected in the instances of the adjustment between the cocoa nearest future price in New York and the cocoa nearest future volume in London, the adjustment between the sugar nearest future price and volume in both London and New York, between the copper nearest future price and volume in New York, and between the copper nearest future price in London and volume in New York. In these cases the error correction response can said to be asymmetrical. The adjustment to the long-run equilibrium takes place at different rates above and below the average level of disturbance. There is no pattern to these cases in terms of London or New York markets across the commodities. In the cases where $\beta_1-\beta_2$ is positive, the short-run disturbance adjusts quicker when it is above average (i.e. positive), and where $\beta_1-\beta_2$ is negative the disturbance adjusts quicker when it is below average (i.e. negative). Positive and negative asymmetry seem not to be specifically connected to the London or New York market.

73. With respect to the asymmetrical nature of the immediate effect of volume on prices, the hypothesis that $\alpha_{11}=\alpha_{12}$ can be tested. The results are not given in table II.5 however, because the tests were only undertaken in the two cases where the immediate effect was shown to be significant by the original error correction results of table II.4. In the case of the cocoa nearest future price in London and volume in New York, the t-value for $\alpha_{11}-\alpha_{12}$ is -1.687 which is significant at the 90% level. For the sugar nearest future price and volume in New York, the t-value for $\alpha_{11}-\alpha_{12}$ is 2.174 which is significant at the 95% level. These results both reject the hypothesis that $\alpha_{11}=\alpha_{12}$ and point to asymmetry in the immediate effect. Thus the rate of immediate adjustment is different above and below the mean level.

74. Overall, these results show that in most cases there appears to be symmetry in the adjustment of the short-run deviation to the long-run equilibrium that exists between commodity nearest future prices and volumes. In only four out of eighteen cases the rate of this adjustment is asymmetrical, differing above and below mean levels of disequilibrium in the relationship. With respect to the commodity markets these certain cases reflect situations where the action of

traders adjusts the market back to its equilibrium from a short-run shock more quickly in the cases where the price is too high for the level of volume (or volume too low for the price), as opposed to the case where the price is too low for the volume level (or the volume too high for the price) or vice versa.

75. Having specified, estimated and tested both standard and asymmetrical error correction models, the parameter constancy or post-sample stability of the standard ECMs was analysed. The values for the time period 27/01/95 to 28/02/95, or the value for February 1995 in the case of the monthly rubber data, were forecast by the relevant ECMs and compared to the actual values. Due to software limitations the first ten observations of the daily data were ignored. Forecast Chi-squared and Chow F statistics were obtained in order to test whether the actual values were significantly different from the forecasts, and thus whether there existed significant parameter inconstancy or post-sample instability. These statistics are presented in table II.5b.

76. In the case of rubber which uses monthly not daily data the tests of parameter constancy are for February 1995. Note that in each case the Chi^2 statistic in question is Chi^2(22) except in the case of monthly data for rubber when it is Chi^2(1). Note also that in each case the Chow F statistic is F(22,x), where x depends on the size of the sample which in turn depends on lag lengths and suchlike, except in the case of monthly data for rubber when it is F(1,41).

77. Evidently, none of the statistics are significant at a 95% or even 90% level. Thus, the forecasts from the ECMs are significantly close to the actual values in every case. There is significant parameter constancy, and post-sample stability. The graphs that follow depict the forecasts and actual values for each case which considered daily data[5]. The title of each graph specifies which series was being forecasted using which series as the independent variable. In rare cases, as can be seen from the graphs (14/02/95 for cocoa price in New York forecast by cocoa volume in London, 28/02/95 for coffee price in New York forecast by coffee volume in London and cotton price in New York forecast by cotton volume in New York, 01/02/95 for copper price in London forecast by copper volume in London, and 06/02/95 for copper price in London forecast by copper volume in New York) a specific daily forecast in question can be seen to be significantly different from the actual value on that day (this can be shown by relevant t-statistics). However, overall, the forecasts are not jointly significantly different from the actual values, in every case.

II.2. Examining the relationship between the futures/physical ratio and price instability

78. In order to test the belief that speculators, both those that manage their own funds and the commodity funds, increase the volatility of the markets in which they trade, the hypothesis that increased futures speculation tends to increase commodity price instability is examined by investigating the relationship between price instability in London and New York, and the ratio of nearest future volume to physical trade in the UK and US respectively.

---

[5] The actual and forecast values vary in size across graphs as the series in question measure different commodities in different units.

79. To investigate the question of speculation and excess speculation, the means of our futures to physical ratios have been obtained for various sub-samples of our overall sample of March 1991-Feb 1995 (as shown in table II.6). Observation of big changes in the ratio might indicate the existence of not only speculation but also excess speculation.

80. The most appropriate way to investigate the question of excess speculation is to establish whether each mean is comparable to the historical mean of the overall sample (as detailed for each commodity in appendix II) presented for each commodity in the last column of table II.6. In the cases where the ratio of the mean futures to physical ratio of the sub-sample in question to the historical mean ratio over the whole sample exceeds one there could justifiably, in one sense, be said to be excess speculation. For example, from the data presented in table II.6, there could be said to be excess speculation in cocoa in the UK only over the year preceding December 1993 when the ratio of the mean futures to physical ratio to its historical mean equalled more than one (1.05). Whereas, for example, there appears to be excess speculation, as defined here, for copper in the US (looking at CPUSRATIO1) from 1993 onwards when the ratio of the sub-sample mean futures to physical ratio to the historical mean over the whole sample equalled 1.30 (1993) and 1.26 (1994). Using this criterion for excess speculation, it becomes apparent from table II.6 that in every case a situation of excess speculation was reached in either 1993 or 1994. Only the ratios CFUKRATIO and CPUSRATIO2 declined from 1993 to 1994 and even th n the former still represents an excess speculation position.

81. The evidence presented in table II.6 suggests in general terms that, whilst there has been a steady increase in the level of speculation throughout the period of our sample, it has been during the years of 1993 and 1994 that large increases in speculation have taken place in the cases of some of the commodities in question raising the level of speculation from 1991 and 1992 levels to those of the present.

82. This is particularly obvious, for example, in the cases of cocoa in the US, coffee in the US, rubber in Japan, and copper in the UK, where the average futures to physical ratios rose by 36.7%, 39.1%, 70.1% and 98.8% respectively between 1992 and 1993.

83. To test the relationship between the futures/physical ratio and price instability, testing for cointegration can again be used. This methodology involves integration tests (as the series involved need to be non-stationary and of an equal order of integration) and cointegration tests. Details of the series are as presented in appendix II.

84. Evidently table II.7 shows that the series in question are all I(1).

85. Table II.8 shows that all the price instability indices are cointegrated with their respective futures to physical ratios. Looking at the cointegration test results in this section, it becomes apparent that there is often a distinct relationship between the level of nearest future price instability and the volume of nearest futures being traded (in relation to physical trade). Therefore, it is the case that speculation on commodity markets is related directly to the level of price instability therein. Overall this finding supports the empirical evidence of Labys and Thomas (1975) and Kocagil (1993) and the belief that speculation increases the volatility of the markets on which it takes place.

86. Having established cointegration causality tests were run. The estimated F statistic results indicating whether SP (speculation - the futures to physical ratio) causes PI (price instability) and vice versa are presented in table II.9.

87. The results suggest that in every case the futures to physical ratio, or level of speculation, causes price instability in the markets and samples in question. Moreover, in two cases (cocoa in the USA and coffee in the UK) there appears to be two-way causality between price instability and the level of speculation. These results further support the belief that speculation increases instability in commodity markets.

88. Another issue related to the present analysis, which should be noted, is the hypothesis that the price and volume volatility indices used in this study are related to the time frequency of their measurement. Consequently, the relevant indices have been calculated for the commodities and markets in question in annual, monthly, and weekly form.

89. It is highly evident that the volatility indices are related to the time frequency chosen. The figures decrease from annual to monthly to weekly indices. The following examples show this clearly. The annual price volatility index for coffee nearest futures traded in London in 1994 was 40.85, whilst the average monthly figure for 1994 was 5.53, and the average weekly figure for 1994 was 1.99. In the case of price volatility for cocoa nearest futures traded in New York in 1992 the annual figure was 9.82 whilst the monthly average was 2.93 and the weekly average was 1.84. Meanwhile, the annual volume volatility for cotton nearest futures traded in New York in 1993 was 48.70, whilst the average monthly figure for 1993 was 44.04, and the average weekly figure for 1993 was 38.94. In the case of volume volatility for copper nearest futures traded in London in 1991 (March-December) the annual figure was 28.35 whilst the monthly average was 26.48 and the weekly average was 19.83.

90. The indices for all commodities, markets, and periods in this study appear to follow the same pattern. However, the effect which causes the indices to decrease from annual to monthly to weekly calculation is less significant in the case of volume indices than it is in that of price indices.

II.3. Co-movement and excess co-movement of commodity prices

91. The importance of the speculative action based on trends in financial markets and more specifically across commodities in commodity future markets can be considered by examining whether the commodity prices not only co-move but also co-move above and beyond that which can be explained by the movements of the financial variables. It is generally believed that it is unusual for fund investors to put more weight on one commodity than another. Portfolio investment in commodity futures markets is generally in terms of a basket of commodities involving the most important commodities. This portfolio investment across commodities (together with the strength of fundamentals which is examined in the next section) explains the upward movement of prices of almost all commodity prices in the last two years. If this generality of commodity portfolio investment holds then commodity prices will co-move and if it is based on bullish or bearish behaviour in all commodities for no plausible economic reason then they will exhibit excess co-movement.

92. Previously, it has been proved by Pindyck and Rotemberg's (1990) findings that commodity prices co-move above and beyond that which can be explained by the movements of the financial variables.

93. In order to test whether commodity prices have a persistent tendency to move together, tests are performed for co-movement between the commodities considered by this paper, and also for co-movement in excess of anything that could be explained by the common effects of macroeconomic behaviour.

94. Pindyck and Rotemberg (1990) found co-movement of commodity prices beyond that which could be explained by the effects of past, current or expected future values of macro-economic variables such as inflation, industrial protection, interest rates or exchange rates. They attributed this excess co-movement to either 'herd' behaviour in commodity markets, or to the absence of some important macroeconomic variable or variables from their analysis. They doubted the second explanation, without completely ruling it out, because they experimented extensively with macroeconomic variables.

95. Palaskas and Varangis (1991) also produced test results to support the hypothesis of co-movement between commodity prices, using a cointegration test as well as some methodology similar to that of Pindyck and Rotemberg (1990). However, they suggested that, in the case of annual data common shocks explain almost all the co-movement between commodity prices, with some exceptions, even if monthly data presented problems leading to inconclusive results. Nevertheless, they did suggest an alternative explanation for excess co-movement, pointing to the possibility that traders take time to distinguish between macroeconomic shocks and commodity-specific supply shocks.

96. The present study also tests for co-movement and excess co-movement between the commodity prices under consideration, examining both the London and New York markets.

97. With respect to co-movement, tests follow the methodology presented by Pindyck and Rotemberg (1990). Tables II.10 and II.11 show the correlation matrices for daily changes in the logarithms of commodity prices (nearest futures for cocoa, coffee, sugar, cotton and copper, and cash for rubber), in London and New York respectively.

98. In order to test whether the correlations as a group (and thus the co-movement in general) are statistically significant, a likelihood ratio test of the hypothesis that the correlation matrix is equal to the identity matrix can be performed. The test statistic, indicated by Pindyck and Rotemberg (1990) is $-2\log\lambda$, which is distributed as χ^2 with $p(p-1)/2$ degrees of freedom, where p is the number of commodities. λ is the ratio of the restricted to unrestricted likelihood function which is equal to, as shown by Morrison (1967), $|R|^{n/2}$ where $|R|$ is the determinant of the correlation matrix.

99. The above results (test statistics given below respective tables) of 263.307 and 60.041 for London and New York respectively allow the rejection of the hypothesis that the commodity prices are uncorrelated, and the acceptance of the existence of co-movement in both cases, at a 99% level of significance.

100. In order to test for excess co-movement, it is firstly hypothesised that commodity prices may have common movements because of macroeconomic changes. To allow for such effects, the commodity prices are regressed on a selection of macroeconomic and financial variables. The residuals are then taken, and a correlation matrix is constructed for these residuals, as described by Pindyck and Rotemberg (1990). Any co-movement between the residuals can be identified as above, and thus excess co-movement (that in addition to that which can be explained by changes in macroeconomic variables) can be established.

101. In the present study daily changes in logged commodity prices are regressed on daily changes of the thirteen logged macroeconomic and financial variables described in the appendix (specification 1), and on daily changes of six of these logged variables (sterling, deutschmark and yen against the dollar, 3-month US Treasury bills, the FT-SE 100 Index, and the S&P 500 Index) in terms of current values, and values lagged once (specification 2).

102. The resulting test statistics calculated from the correlation matrices of the residuals for London and New York are given in table II.12.

103. In all four cases the test statistics reject the hypothesis of uncorrelated residuals, and thus allow the acceptance of the hypothesis of excess co-movement, at a 99% level of significance. It appears, therefore, that co-movement does seem to exist between the commodity prices examined in this paper in London and New York, using daily data. They move together in excess of that which can be explained by macroeconomic changes. In addition to the explanation of 'herd' behaviour such findings could also be explained by portfolio investment in commodities during the sample used. This generality of commodity portfolio investment, together with the impact of sharp demand growth, seems to explain the fact that almost all primary commodities rose in price during 1994, and can thus explain at least some of the excess co-movement of commodity prices found here.

II.4. The effect of fundamentals (stocks) on recent commodity price behaviour

104. Another important cause lying behind the reverse price movement in the last two years compared to the depressed commodity prices up to 1993 is that of fundamentals. Therefore econometric analysis is undertaken in this section to examine whether the shifts in demand and supply corroborated in the level of stocks contributed to the recent increase in commodity prices. The results (see table II.13) of logged (L) monthly prices in levels regressed on a logged (L) monthly stocks variable (in some cases this takes a lagged or first difference form) and a constant show that for sugar, rubber, cotton and copper[6] there is a negative and statistically significant relationship between prices and stocks.

105. The results in table II.13 confirm a relationship between stocks and prices. They make it particularly clear that the relationship is a negative one. As stocks rise, prices fall, and vice versa. When stocks are low, there is little to offset any shocks and thus the price may rise. When stocks are high, however, the price can remain low as shocks can easily be accommodated.

---

[6] Unfortunately there is no available monthly stocks data for cocoa and coffee, nor is it possible to create monthly excess supply data.

106. The hypothesis that the level of stocks of a commodity affects the instability of the price of that commodity is also examined by testing the relationship between levels of stocks in the UK and US and price instability in London and New York respectively. This is undertaken by again testing for cointegration. This methodology involves integration tests (as the series involved need to be non-stationary and of an equal order of integration) and cointegration tests. Details of the series used, and those used in the regressions appearing later in this section are presented in appendix III.

107. Thus table II.14 shows that the series in question are I(1).

108. Table II.15 shows that the price instability indices are cointegrated with the respective stocks series. Thus it is apparent that there is a distinct long-run relationship between nearest future price (or cash) price instability and stock levels. Fundamentals, it appears, are related to price volatility in the long-run, even if the relationship between the two may diverge in the short-term. In most cases it appears from the coefficients that an increase in stocks is associated with a decrease in price volatility. This can be explained by the fact that a higher level of stocks leads to a greater capacity for the market to absorb shocks and thus keep prices stable. However, with respect to the copper market it appears that the relationship between stocks and price volatility is positive. This might be due to the availability of a close substitute for copper (aluminium). Having established cointegration causality tests were run to determine whether it is the case that stock levels (fundamentals) cause price volatility or vice versa. Further analysis might establish the direction of causality between price instability and stock levels. The estimated F statistic results indicating whether ST (stock levels) cause PI (price instability) and vice versa are presented in table II.16.

109. The results suggest that the shifts in demand and supply corroborated in the level of stocks cause price instability in the markets in question. This is evidence that it is in fact the fundamentals which are behind levels of price volatility in the commodities markets.

II.5. Commodity price instability and the instability of the earnings of commodity exporting countries

110. Given the instability in commodity prices discussed earlier, it is clear that those countries specialising in the export of commodities, or one commodity, will experience instability in their export earnings. This paper has evaluated as causes of such commodity price instability the roles of speculation in the form of portfolio investment, and the fundamentals of supply and demand largely in the form of stocks. Thus, through the effects of price instability these factors have a great effect on the export earnings of those countries specialising in commodity exports who are mainly developing countries.

111. Table II.17 illustrates the role that the commodities discussed in this paper play in the exports of certain developing countries, and the role their exports of these commodities play in world markets. It also presents a measure of the price instability of the commodities in question.

112. It is evident from table II.17 that many developing countries are highly dependent upon the exports of certain commodities. This, for example, is

particularly true of Zambia for which copper constituted 81.56% of all exports in 1989-90, Ghana for which cocoa represented 39.40%, and Guyana for which sugar constituted 32.69% of all sugar exports.

113. The reversed trend in the prices of these commodities in the last two years will benefit the LDC exporters, in comparison to the losses they faced in 1991-92. The 1993 UNCTAD Trade and Development Report estimates that in 1991-92 developing countries lost $18.94 billion (14.8% of their commodity earnings) due to falling prices. Those in Latin America lost $11.91 billion (21.4% of commodity earnings), those in Africa lost $4.35 billion (24.0%) and those in Asia lost $2.68 billion (4.9%).

114. However, these benefits are subject to uncertainty arising from the price instability of the exported commodities. Countries heavily dependent on high-instability commodities for the bulk of their export earnings are generally acknowledged to be subject to extra constraints on their economic development. Fluctuations in export earnings can have an adverse effect on domestic savings and the domestic budget, and consequently are likely to accentuate the variability of imported capital and intermediate goods, which in turn can have an adverse impact on domestic investment.

115. The uncertainty of the benefits will be higher and the constraints on the economic development of the LDCs stronger in the case that rises in commodity prices are due to speculation because increases in the latter cause higher instability in the former.

116. The rise in price linked to the increase in speculation leads to price instability and consequently to instability in the value of exports and income of many of the developing countries. Such instability and losses in income create huge problems for the developing countries in the face of their debts and necessary repayments.

III. Conclusions

117. There have been dramatic changes in the financial markets in the last two decades. The number of futures contracts rose by 280% between 1980 and 1990 while the composition of the commodities that were traded thirty years ago compared to those that are traded today has also changed dramatically. Thirty years ago agricultural commodities futures contracts were dominating the markets. Today more than half of all futures trading is in financial instruments. The volume of speculative trading in futures markets is substantial and increasing constantly.

118. This study used econometric analysis to quantify the short-run and long-run influences of financial market movements and instability particularly that resulting from transactions in futures and derivatives contracts, on the behaviour and instability of international commodity prices. The econometric analysis is applied to six of the most important commodities : cocoa, coffee, sugar, rubber, cotton and copper, using daily nearest future price and volume of future contracts for the period March 1991-February 1995.

119. The results uniformly suggest that a long-run stationary relationship exists between the futures prices and the volume of futures contracts of the six commodities within and across the two markets, and that although the two

variables may move away from their long-run equilibrium in the short-run, there will always be market forces pushing them back to it. The period required for the two variables to adjust to long-run equilibrium varies within the markets from eighteen days for coffee in New York to one day only for sugar in New York, and across markets from thirty-one days for copper to one day for cocoa. The hypothesis of asymmetrical adjustment was rejected in fourteen out of eighteen cases. On the other hand, the lag effect between the future price and futures activity is zero or at most one period. However, no short-run or immediate effect was established.

120. Next the direction of causality between the two series together with their exogeneity with respect to each other was examined. The combined results of causality and exogeneity show that it is the price within and across markets that causes the volume of transactions and not vice versa, and that the causing variable (price) is strongly exogenous.

121. Turning to the question of speculation and price volatility, the findings reject the widely accepted view that an increase in the intensity of futures speculation tends to decrease price volatility, even though in the period under consideration there has been a dramatic increase in speculation. It also established in every case that the level of speculation causes price instability and not vice versa (excluding two cases where feedback was found) within the two markets.

122. With respect to the issue of co-movement and excess co-movement of commodity prices, the findings of this paper confirm the view that commodity prices not only co move but also co-move above and beyond that which can be explained by the movements of financial variables. Macrovariables play an important role in explaining the variation of market commodity prices. Also it is established that a special statistical relationship exists between the commodity prices under consideration and Eurodollar 3-month futures and US 3-month Treasury bill futures. The co-movement may also be attributed to commodity portfolio investment. However, the excess co-movement could be due to other factors than macroeconomic factors. Instead, this could be due to commodity market speculative behaviour based on trends, but could also be due, given the increase in portfolio investment in commodities during the period under consideration, to the generality of fund investment in commodities.

123. In addition, the role of fundamentals corroborated in stocks in the movement of the commodity prices under consideration, and more specifically in their upward movement in the last two years, was econometrically investigated and analysed. The findings of this paper suggest that fundamentals play a prominent role in the determination of commodity price behaviour. Econometric analysis found the relationship between prices and stocks to be significantly negative considering the sugar, rubber, cotton and copper markets. As stocks corroborate the fundamentals of supply and demand, this shows that fundamentals influence the price; as stocks fall, prices rise and vice versa. With respect to price instability econometric analysis also found a long-run relationship between stocks and price instability in the cases of sugar, rubber, cotton and copper. Causality tests showed that stocks cause price instability in these cases. Evidently, the fundamentals also determine price instability. The relationship was found to be negative in general (although positive in the case of copper, a result, it is hypothesized, influenced by copper's substitutability for aluminium).

124. Finally this document evaluated the effect of price changes in commodity markets on developing countries specialising in the export of one or more commodities. Although the recent rise in prices may benefit the LDC exporters, the uncertainty of the benefits will be higher as rises in prices resulting from speculation increase price instability. As a result, constraints on the economic development of LDCs will be stronger.

Appendix I

The series described in this section are denoted according to the following rules. L stands for a series constructed in logarithms of actual values. Where M follows L it indicates that the series is a monthly one. The next letters signify the commodity in question (CC=cocoa, CF=coffee, SU=sugar, CT=cotton, RB=rubber, and CP=copper). The subsequent letters indicate the location of the market in question (LON=London, NY=New York, and KO=Kobe). The following F indicates nearest future prices, whilst a final P or V indicates price or volume.

Note that the sample 'ALL' refers to Mar 1991- Feb 1995.

(i) Period: 1/3/91-28/2/95 (1010 observations)
except for LRBKOF 6/5/93/-28/2/95 (458 observations)

(ii)(a) Commodities:

LCCLONF: Cocoa Market Futures, FOX London, $/tonne
LCCNYF: Cocoa Market Futures, CSCE New York, $/tonne
LCFLONF: Coffee Market Futures, FOX London, $/tonne
LCFNYF: Coffee 'C' Market Futures, CSCE New York, $/tonne
LSULONF: Sugar Market Futures, LCE London, $/tonne
LSUNYF: Sugar Market Futures, CSCE New York, cent/lb.
LCTNYF: Cotton Market Futures, NYCE New York, cent/lb.
LRBKOF: Rubber Market Futures, KOBE Rubber Exchange, cent/lb.
LCPLONF: Copper Market Futures, LME London,, $/tonne
LCPNYF: Copper Market Futures, COMEX New York. cent/lb.

(ii)(b) Financial Variables:

LDMCHF: DM/$ Market Futures, International Monetary Market (IMM), CME Chicago
LYNMAF: YEN/$ Market Futures, Mid America (MIDAM)
LSTCHF: £/$ Market Futures, IMM, CME Chicago
LEDCHF: Eurodollar 3-month, Market Futures, IMM, CME Chicago
LSSLONF: Short £3-month, Market Futures, London International Financial Futures Exchange (LIFFE)
LNKOSF: NIKKEI 225 Index, Market Futures, OSAKA
LSPCHF: S&P 500 Index, Market Futures, Index & Options Market (IOM), CME
LTBCHF: Treasury Bill, U.S, 3-Month, Market Futures, IMM, Chicago
LFTLONF: FT-SE 100 Index, Market Futures, IOM, London
LNYNYF: NYSE Composite Index, Market Futures, New York,
LDXDTF: DAX GERMAN Index, Market Futures, Deutsche Terminborse (DTB),
LTBMAF: Treasury Bond U.S 30-Year, Market Futures, MIDAM,
LYBLONF: YEN Bond Japan 20:Year, Market Futures, LIFFE, London.

With respect to the collection of data, in many cases daily data was obtained for many trading positions. The nearest future position in each case was taken to construct our own daily data series.

Appendix II

The following data is used in the section on price instability and futures to physical ratios.

Monthly price instability is calculated from daily prices.

Quarterly price instability is calculated as an average of monthly values.

COCOA

12 quarterly observations, April/June 1991-January/March 1994

CCLNFPI:	quarterly price instability index for nearest future price, London, constructed from daily price series
CCNYNFPI:	quarterly price instability index for nearest future price, New York, constructed from daily price series
CCUKIMPS:	UK imports, quarterly, tonnes
CCUSIMPS:	US imports, quarterly, tonnes
CCLNFVL:	nearest future volume, London, quarterly, tonnes
CCNYFVL:	nearest future volume, New York, quarterly, tonnes
CCUKRATIO:	CCLONNFVL/CCUKIMPS
CCUSRATIO:	CCNYNFVL/CCUSIMPS

COFFEE

46 monthly observations, March 1991 - December 1994

CFNYFPI:	monthly price instability index for nearest future price, New York, constructed from daily price series
CFLNFPI:	monthly price instability index for nearest future price, London, constructed from daily price series
CFUSIMPS:	US imports, monthly, tonnes
CFUKIMPS:	UK imports, monthly, tonnes
CFNYFVL:	nearest future volume, New York, monthly
CFLNFVL:	nearest future volume, London, monthly
CFUSRATIO:	CFNYFVL/CFUSIMPS, monthly
CFUKRATIO:	CFLNFVL/CFUKIMPS, monthly

SUGAR

46 monthly observations, January 1991 - December 1994

SUNYFPI:	monthly price instability index for nearest future price, New York, constructed from daily price series
SUUSIMPS:	US imports, monthly, tonnes
SUNYFVL:	nearest future volume, New York, monthly, tonnes
SUUSRATIO:	SUNYFVL/SUUSIMPS

RUBBER

46 monthly observations, March 1991 - December 1994

RBNYCPI: monthly price instability index for cash price, New York, constructed from daily price series
RBJIMPS: Japanese imports, monthly, tonnes
RBJCONS: Japanese consumption, monthly, tonnes
RBKONFVL: nearest future volume, Kobe, tonnes, monthly
RBJRATIO1: RBKONFVL/RBJIMPS, monthly
RBJRATIO2: RBKONFVL/RBJCONS, monthly

COTTON

48 monthly observations, March 1991 - Feb 1995

CTNYFPI: monthly price instability index for nearest future price, New York, constructed from daily price series
CTUSCONS: US consumption, monthly, tonnes
CTNYFVL: nearest future volume, New York, monthly, tonnes
CTUSRATIO: CTNYFVL/CTUSCONS

COPPER

48 monthly observations, March 1991- Feb 1995

CPLNFPI: monthly price instability index for nearest future price, London, constructed from daily price series
CPNYFPI: monthly price instability index for nearest future price, New York, constructed from daily price series
CPUKCONS: UK consumption, monthly, tonnes
CPUSIMPS: US imports, monthly, tonnes
CPUSCONS: US consumption, monthly, tonnes
CPLNFVL: nearest future volume, London, tonnes
CPNYFVL: nearest future volume, New York, tonnes
CPUKRATIO: CPLNFVL/CPUKCONS
CPUSRATIO1: CPNYFVL/CPUSCONS
CPUSRATIO2: CPNYFVL/CPUSIMPS

Appendix III

Monthly price instability is calculated from daily prices.

The following data is used in the section on stocks and price instability.

SUGAR

40 monthly observations, March 1991-June 1994

SGECTSX: EC stocks at end of month
SGLNFPI: monthly price instability index for nearest future price, London, constructed from daily price series
SULNFP: monthly nearest futures price, London

RUBBER

46 monthly observations, March 1991-December 1994

RBUSSTX: US stocks at end of month
RBTCSTX: total world consumer stocks at end of month
RBNYCPI: monthly price instability index for cash price, New York, constructed from daily price series
RBNYCP: monthly cash price, New York
RBLNCP: monthly cash price, London

COTTON

48 monthly observations, March 1991-February 1995

CTUSSTX: US stocks at end of month
CTNYFPI: monthly price instability index for nearest future price, New York, constructed from daily price series
CTNYFP: monthly nearest futures price, New York

COPPER

48 monthly observations, March 1991-February 1995

CPUKSTX: UK stocks at end of month
CPUSSTX: US stocks at end of month
CPLNFPI: monthly price instability index for nearest future price, London, constructed from daily price series
CPNYFPI: monthly price instability index for nearest future price, New York, constructed from daily price series
CPLNFP: monthly nearest futures price, London
CPNYFP: monthly nearest futures price, New York

References

Baumol, W.J. (1957) "Speculation, profitability, and stability", *R.E.Stat.*, 39, 263-71.

Beenstock, M. (1988) "An Econometric Investigation of North-South Interdependence", Ch.2 in D. Currie and D. Vines (eds), *Macroeconomic Interaction Between North and South*, Cambridge University Press.

Breusch, T.A. and A.R. Pagan (1980) "The Lagrange multiplier Test and its Application to Model Specification in Econometrics", *Review of Economic Studies*,47, 239-253.

Broughton, J. and W. Branson (1991) "Commodity Prices as a Leading Indicator of Inflation", Ch.17 in K.Lahiri and G. Moore, *Leading Economic Indicators*, Cambridge University Press.

Broughton, J. (1991) "Commodity and Manufacturing Prices in the Long-Run", IMF Seminar Paper.

Claessens, S., M.P.D. Dooley, and A. Warner (1995) "Portfolio Capital Flows : Hot or Cold?", *The World Bank Economic Review*, vol 9., no. 11, 153-174.

Dickey, D.A., and W.A. Fuller (1979) "Distribution of the estimators for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association*, 74, 427-431.

Dornbusch, R. (1976) "Expectations and Exchange Rate Dynamics", *Journal of Political Economy*, 84, 1161-76.

Durand, M. and S. Blondal (1988) "Are Commodity Prices Leading Indicators of the OECD Prices?", OECD Working Paper Series 10799.

Edwards, F.R., and C.W. Ma (1992) "Futures and Options", McGraw Hill.

Engle, R.F., and C.W.J. Granger (1987) "Co-integration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55,251-276.

Farrell, M.J. "Profitable Speculation", *Economica*, 33, 183-93.

Frankel, J. (1986) "Expectations and Commodity Price Dynamics: The Overshooting Model", *American Journal of Agricultural Economics*, 68, 344-358.

Friedman, M. (1953) "Essays in Positive Economics", Chicago University Press.

Ghosh, S., C.L. Gilbert and A.J. Hughes Hallett (1987) "Stabilizing Speculative Commodity Markets", Clarendon Press, Oxford.

Gilbert, C.L. (1994) "Commodity Funds Activity and The World Cocoa Market", London Commodity Exchange.

Gilbert, C.L. (1994) and T. Palaskas (1990) "Modelling Expectations Formation in Primary Commodity Markets" in Winters, L.A. and D. Sapsford (eds.), *Primary Commodity Prices: Economic Models and Policy*, Cambridge University Press.

T. Palaskas (1990) "The Impact of Exchange Rates and Developing Country Debt on Commodity Prices", *The Economic Journal*, 99, 773-784.

Granger, C.W.J. (1986) "Developments in the Study of Cointegrated Economic Variables", *Oxford Bulletin of Economics and Statistics*, 48, 3.

Grossman, S.J. (1977) "The Existence of Futures Markets, Noisy Rational Expectations, and Information Externalities", *Review of Economic Studies*, 44, 431-49.

Grossman, S.J. and J.E. Stiglitz (1980) "On the Impossibility of Informationally Efficient Markets", *American Economic Review*, 70, 393-409.

Harrison, J.M. and D.M. Kreps (1978) "Speculative Investor Behaviour in a Stock Market with Heterogenous Expectations", *Quarterly Journal of Economics*, 92, 323-36.

Hart, O.D. (1977) "On the profitability of speculation", *Quarterly Journal of Economics*, 91, 579-97.

Hendry, D.F. (1995) "Dynamic Econometrics", Oxford University Press.

Hirschliefer, J. (1975) "Speculation and Equilibrium : Information, Risk and Markets", *Quarterly Journal of Economics*, 89, 519-42.

Kemp, M.C. (1963) "Speculation, Profitability, and Price Stability", *Review of Economics and Statistics*, 45, 185-9.

Kocagil, A.E.(1993) "Does Futures Speculation Stabilize Spot Prices? - Evidence from Metals Markets", Working Paper Series, #88, Penn State University.

Kwiatowski et al. (1992) "Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root", *Journal of Econometrics*, 54, 159-178.

Labys, W.C, and H.C. Thomas (1975) "Speculation, Hedging and Commodity Price Behaviour: An International Comparison", *Applied Economics*,7,287-301.

Labys, W.C., H.C. Thomas and D.J. Gijsbers (1986) "Monetary and Economic Influences in Econometric Models of International Commodity Price Behaviour", UNCTAD.

MacBean, A.I. and D.T. Nguyen (1987) "Commodity Policies, Problems and Prospects", Croom Helm, London.

McNicol, D.L. (1978) "Commodity Agreements and Price Stabilization", Lexington, Mass., D.C.Heath.

Maizels A. and T. Palaskas (1994) "The Common Fund and the Behaviour of the Ten 'Core' Commodity Prices", QEH Seminar Paper, Oxford.

Morrison, D.F. (1967) "Multivariate Statistical Methods", McGraw Hill, New York.

Nunnenkamp, P. (1993) "The Return of Foreign Capital to Latin America", Kiel Working Paper, Kiel Institute of World Economics, Germany.

Palaskas, T. and P. Varangis (1989) "Primary Commodity Prices and Macroeconomic Variables: A Long-Run Relationship?", PRE Working Paper 314, World Bank.

Palaskas, T. and P. Varangis (1991) "Is There Excess Comovement of Primary Commodity Prices? A Cointegration Test", PRE Working Paper Series 758, World Bank.

Pindyck, R.S, and J.J. Rotemberg (1990) "The Excess Co-movement of Commodity Prices", *The Economic Journal*, 100, 1173-189.

Powell, A. (1989) "Commodity and Developing Country Terms of Trade. What Does The Long-Run Show?", Nuffield College, Oxford, mimeo.

Reisen, H. (1993) "The Case for Sterilized Intervention in Latin America", OECD Development Centre.

Telser, L.G. (1958) "Futures Trading and the Storage of Cotton and Wheat", *Journal of Political Economy*, 66, 233.

Turner, P. (1991) "Capital Flows in the 1980s : A Survey of Major Trends", BIS Economic Papers 30, Basel : Bank for International Settlements.

UNCTAD Trade and Development Report, 1993, UNCTAD.

Table I.1a
LDC shares of world exports of six 'core commodities' 1989-1990

SITC	Commodity	% share
061	Sugar	63
071	Coffee	81
072	Cocoa	73
232	Rubber	97
263	Cotton	40
2871	Copper ores	53 (a)

(Data source : UNCTAD Handbook of International Trade and Development Statistics, 1992, except (a) : 1990 figure only, UN International Trade Statistics Yearbook, 1993.)

Table I.1b
Estimated short-run price elasticities

	Demand	Supply
Cocoa	-0.30	0.13 (Ghana)
Coffee	-0.17	0.06
Sugar (long-run)	-0.31 (EC-9)	0.76 (EC-9)
Rubber	-0.20	0.15
Cotton	n/a	0.66 (Greece)
Copper	-0.30	0.06

(Data sources : Cocoa - Scandizzo and Diakosawas, Instability in the terms of trade of primary commodities 1900-1982, FAO; World Bank Commodity Handbooks - Coffee from June 1985, Rubber from February 1981; Copper - W.Labys, Market Structure, Bargaining Power and Resource Price Formation, 1980; Sugar - D.Leuck and S.Neff, USDA, 1991; Cotton - G.P.Zanias, An Estimation of the Supply Response of Cotton in Greece from 1950 to 1979, Oxford Agrarian Studies, 1981.)

Table I.2
Variation in commodity and manufacture prices 1951-75

	High	Low	Ratio	C.V.
Cocoa	190.7	54.9	3.47	0.29
Coffee	288.2	100.0	2.88	0.25
Sugar	128.7	16.9	7.62	0.61
Rubber	531.6	100.0	5.32	0.38
Cotton	227.1	100.0	2.27	0.22
Copper	285.3	100.0	2.85	0.33
Electrical machinery and equipment	127.0	100.0	1.27	0.06
Mechanical power and transmission equipment	103.0	74.3	1.39	0.10
New cars	153.2	100.0	1.53	0.13
Women's and girls' apparel	140.8	100.0	1.41	0.08

(Notes on Table I.2 : Commodity prices deflated by the UN world price index for all commodities. Prices of electrical machinery and equipment and mechanical power and transmission equipment deflated by the US wholesale price index (durable manufactures). Prices of new cars and women's and girls' apparel deflated by the US consumer price index. All prices scaled with 1975=100. The price series for new cars starts in 1953.)

Table I.3
Variations in commodity prices March 1991-Feb 1995

		High	Low	Ratio	C.V.
London	Cocoa, n.f.	124	498	2.26	0.20
	Coffee, n.f.	4263	653	6.53	0.65
	Sugar, n.f.	42700	24520	1.74	0.14
	Rubber, cash	123	47.75	2.58	0.25
	Copper, n.f.	3070	1619.5	1.90	0.14
New York	Cocoa, n.f.	1522	792	1.92	0.15
	Coffee, n.f.	245.5	8.25	5.09	0.48
	Sugar, n.f.	15.74	7.42	2.12	0.18
	Rubber, cash	94.5	42.5	2.22	0.23
	Cotton, n.f.	105.75	51.07	2.07	0.17
	Copper, n.f.	142.7	72.6	1.97	0.15

(Note : n.f. = nearest future, C.V. = coefficient of variation, and the definition of the variables is given in Appendix I.a.)

Table I.4a : Cocoa futures in the 1990s

COCOA FUTURES	1991/92	1992/93	1993/94
LONDON NEAREST FUTURE VOL (000 tonnes)	2764.1	2912.3	2598.3
LONDON (UK) FUTURES/PHYSICAL RATIO	14.92	18.17	insufficient 1994 cocoa imports data
NEW YORK NEAREST FUTURE VOL (000 tonnes)	13673.9	18420.6	24970.7
NEW YORK (US) FUTURES/PHYSICAL RATIO	34.66	46.65	insufficient 1994 cocoa imports data

Table I.4b : Coffee futures in the 1990s

COFFEE FUTURES	1991/92	1992/93	1993/94
LONDON NEAREST FUTURE VOL (000 tonnes)	599.2	893.7	896.4
LONDON (UK) FUTURES/PHYSICAL RATIO	3.4	4.7	4.3
NEW YORK NEAREST FUTURE VOL (000 tonnes)	33732.7	42460.6	46823.0
NEW YORK (US) FUTURES/PHYSICAL RATIO	24.7	34.6	46.7

Table I.4c : Sugar futures in the 1990s

SUGAR FUTURES	1991 (Mar-Dec)	1992	1993
LONDON NEAREST FUTURE VOL 000 tonnes	5284.3	8330.8	8085.7
LONDON/EC FUTURES/PHYSICAL RATIO	3.63	4.66	4.72
NEW YORK NEAREST FUTURE VOL 000 tonnes	176236	186048	217694
NEW YORK (US) FUTURES/PHYSICAL RATIO	85.69	91.72	119.04

Table I.4d : Rubber futures in the 1990s

RUBBER FUTURES	1992	1993	1994
KOBE NEAREST FUTURE VOL 000 tonnes	3959.7	6375.3	14669.4
KOBE (JAPAN) FUTURES/PHYSICAL RATIO	5.86	10.06	22.77

Table I.4e : Cotton futures in the 1990s *

COTTON FUTURES	1991/92	1992/93	1993/94
NEW YORK NEAREST FUTURE VOL 000 tonnes	36371.2	37004	47310.5
NEW YORK (US) FUTURES/PHYSICAL RATIO	10.27	11.00	12.57

* We have been unable to obtain useful data on cotton traded in the UK.

Table I.4f : Copper futures in the 1990s

COPPER FUTURES	1992	1993	1994
LONDON NEAREST FUTURE VOL 000 tonnes	8594	17644	20541
LONDON (UK) FUTURES/PHYSICAL RATIO	27.63	54.29	54.49
NEW YORK NEAREST FUTURE VOL 000 tonnes	903	1124	1487
NEW YORK (US) FUTURES/PHYSICAL RATIO	3.11	3.29	3.15

Table II.1 : Testing price and volume series for their order of integration

VARIABLE : Y	ADF-STAT. FOR Y	ADF-STAT. FOR ΔY
LCCLONFP	0.964	-31.648
LCCLONFV	-2.041	-27.799
LCCNYFP	0.357	-24.622
LCCNYFV	-0.124	-17.299
LCFLONFP	1.465	-29.374
LCFLONFV	-2.208	-24.720
LCFNYFP	0.831	-30.845
LCFNYFV	-0.072	-17.493
LSULONFP	0.665	-35.060
LSULONFV	-0.327	-15.128
LSUNYFP	0.526	-24.315
LSUNYFV	-0.156	-20.287
LCTNYFP	0.379	-30.904
LCTNYFV	0.054	-15.679
LCPLONFP	0.473	-35.350
LCPLONFV	0.271	-14.232
LCPNYFP	0.316	-31.175
LCPNYFV	0.024	-18.148
LMRBKOFP	0.456	-8.418
LMRBKOFV	0.886	-7.301

Table II.2 : Cointegration tests

			SAMPLE	ADF-STAT	COEFF.	S.Error
COCOA	LCCLONFP	LCCLONFV	ALL	-8.033	1.010	0.010
	LCCNYFP	LCCNYFV	ALL	-19.474	0.797	0.041
	LCCLONFP	LCCNYFV	ALL	-20.030	0.756	0.038
	LCCNYFP	LCCLONFV	ALL	-7.988	1.064	0.133
COFFEE	LCFLONFP	LCFLONFV	ALL	-7.503	1.195	0.159
	LCFNYFP	LCFNYFV	1992-	-3.883	0.490	0.126
	LCFLONFP	LCFNYFV	1992-	-5.129	0.788	0.154
	LCFNYFP	LCFLONFV	ALL	-7.143	0.745	0.104
SUGAR	LSULONFP	LSULONFV	ALL	-15.247	1.609	0.105
	LSUNYFP	LSUNYFV	ALL	-9.209	0.241	0.026
	LSULONFP	LSUNYFV	ALL	-9.809	1.071	0.109
	LSUNYFP	LSULONFV	ALL	-14.541	0.363	0.044
COTTON	LCTNYFP	LCTNYFV	ALL	-7.704	0.476	0.061
COPPER	LCPLONFP	LCPLONFV	ALL	-3.934	0.724	0.001
	LCPNYFP	LCPNYFV	ALL	-7.372	0.516	0.069
	LCPLONFP	LCPNYFV	ALL	-8.952	0.863	0.002
	LCPNYFP	LCPLONFV	1993-	-4.798	0.416	0.001
RUBBER	LMRBKOFP	LMRBKOFV	ALL	-4.636	0.399	0.089

Critical values : reject H_0 of non-cointegration if ADF statistic is lower than -3.17(95%) or -3.75(99%).

Table II.3a: Causality tests between nearest future commodity prices and the volume of transactions

COMMODITY	P_{it}	Q_{it}	SAMPLE	$F : Q_{it} \rightarrow P_{it}$	$F : Q_{it} \leftarrow P_{it}$
COCOA	LCCLONFP	LCCLONFV	ALL	2.248 (1,1007)	90.553** (1,1007)
	LCCNYFP	LCCNYFV	ALL	2.158 (1,1007)	323.241** (1,1007)
	LCCLONFP	LCCNYFV	ALL	3.314 (1,1007)	397.585** (1,1007)
	LCCNYFP	LCCLONFV	ALL	0.877 (1,1007)	89.001** (1,1007)
COFFEE	LCFLONFP	LCFLONFV	ALL	1.612 (1,1007)	125.329** (1,1007)
	LCFNYFP	LCFNYFV	1992-	1.073 (1,796)	44.206** (1,796)
	LCFLONFP	LCFNYFV	1992-	0.390 (1,796)	69.311** (1,796)
	LCFNYFP	LCFLONFV	ALL	1.379 (1,1007)	115.152** (1,1007)
SUGAR	LSULONFP	LSULONFV	ALL	1.216 (1,1007)	417.173** (1,1007)
	LSUNYFP	LSUNFYV	ALL	3.088 (1,1007)	198.090** (1,1007)
	LSULONFP	LSUNYFV	ALL	0.221 (1,1007)	424.039** (1,1007)
	LSUNYFP	LSULONFV	ALL	0.966 (1,1007)	378.818** (1,007)
COTTON	LCTNYFP	LCTNYFV	ALL	2.432 (1,1007)	405.660** (1,1007)
COPPER	LCPLONFP	LCPLONFV	ALL	0.545 (1,1007)	97.788** (1,1007)
	LCPNYFP	LCPNYFV	ALL	0.288 (1,1007)	270.647** (1,1007)
	LCPLONFP	LCPNYFV	ALL	0.002 (1,1007)	319.869** (1,1007)
	LCPNYFP	LCPLONFV	1993-	0.549 (1,542)	66.344** (1,542)
RUBBER	LMRBKOFP	LMRBKOFV	ALL	0.878 (1,45)	9.080** (1,45)

*** and * represent significant causality at 99% and 95% levels respectively. Degrees of freedom for F-statistic in brackets.*

Table II.3b : Weak exogeneity test results

COMMODITY	$P_{i,t}$	$Q_{i,t}$	't' $P_{i,t}$	't' $Q_{i,t}$
COCOA	LCCLONFP	LCCLONFV	-0.276	-4.495**
	LCCNYFP	LCCNYFV	-0.550	-6.401**
	LCCLONFP	LCCNYFV	0.440	-6.955**
	LCCNYFP	LCCLONFV	-1.929	-4.466**
COFFEE	LCFLONFP	LCFLONFV	1.472	-2.895**
	LCFNYFP	LCFNYFV	-0.756	-2.061*
	LCFLONFP	LCFNYFV	-0.359	-2.474*
	LCFNYFP	LCFLONFV	0.818	-2.795**
SUGAR	LSULONFP	LSULONFV	-0.796	-3.036**
	LSUNYFP	LSUNYFV	-0.657	-3.064**
	LSULONFP	LSUNYFV	1.722	-2.712**
	LSUNYFP	LSULONFV	-1.728	-3.000**
COTTON	LCTNYFP	LCTNYFV	-1.405	-3.807**
COPPER	LCPLONFP	LCPLONV	0.033	-3.228**
	LCPNYFP	LCPNYFV	-1.250	-3.882**
	LCPLONFP	LCPNYFV	0.780	-4.161**
	LCPNYFP	LCPLONFV	-0.977	-3.069**
RUBBER	LMRBKOFP	LMRBKOFV	0.523	-2.206*

** and ** indicate rejection of weak exogeneity at a 95% and 99% level of significance respectively. The fourth column presents the t-value for testing the weak exogeneity of $P_{i,t}$ with respect to $Q_{i,t}$. The fifth column presents the t-value for testing the weak exogeneity of $Q_{i,t}$ with respect to $P_{i,t}$.*

Table II.4 : Error correction results

$P_{1,t}$	$Q_{1,t}$	S	SMPL.	$\Delta P_{1,t}$ LAGS	$\Delta Q_{1,t}$ LAGS	β COEFF.	T VALUE	α_1 COEFF.	T VALUE	BP
LCCLONFP	LCCLONFV	16	ALL	0	1	0.0004	1.527 +	0.0003	0.642	5.6 (3)
LCCNYFP	LCCNYFV	5	ALL	2	0	0.0048	2.764**	0.0002	0.160	8.4 (3)
LCCLONFP	LCCNYFV	1	ALL	5	0	0.0047	3.012**	0.0029	2.641**	2.7 (3)
LCCNYFP	LCCLONFV	10	ALL	2	1	0.0005	1.741 +	0.0010	1.746	7.0 (3)
LCFLONFP	LCFLONFV	2	ALL	2	0	0.0005	1.624 +	0.0002	0.420	3.4 (3)
LCFNYFP	LCFNYFV	18	1992	0	0	0.0034	1.564 +	0.0038	1.617	3. (3)
LCFLONFP	LCFNYFV	23	1992	1	1	0.0022	1.564 +	0.0006	0.278	4.7 (3)
LCFNYFP	LCFLONFV	8	ALL	0	0	0.0016	1.867**	0.0002	0.471	8.1 (3)
LSULONFP	LSULONFV	2	ALL	1	0	0.0006	1.588 +	0.0008	1.747	2.9 (3)
LSUNYFP	LSUNYFV	1	ALL	2	0	0.0047	2.648**	0.0026	2.205*	7.5 (3)
LSULONFP	LSUNYFV	2	ALL	1	0	0.0011	1.824*	0.0009	1.444	2.3 (3)
LSUNYFP	LSULONFV	2	ALL	2	0	0.0056	2.703**	0.0004	0.307	4.6 (3)
LCTNYFP	LCTNYFV	5	ALL	2	1	0.0052	2.842**	0.0005	0.721	2.0 (3)
LCPLONFP	LCPLONFV	3	ALL	2	0	0.0017	2.043*	0.0004	0.388	5.0 (3)
LCPNYFP	LCPNYFV	3	ALL	0	0	0.0026	1.876*	0.0012	1.629	2.3 (3)
LCPLONFP	LCPNYFV	4	ALL	1	1	0.0021	2.771**	0.0014	1.382	1.2 (3)
LCPNYFP	LCPLONFV	31	1993	1	1	0.0049	1.768 +	0.0017	0.931	5.4 (3)
LMRBKOFP	LMRBKOFV	1	ALL	9	1	0.1399	2.183*	0.0202	0.665	2.7 (3)

*+, * and ** represent significance at 90%, 95% and 99% respectively.*

Table II.5 : Asymmetrical error correction results

P_{t-1}	P_{t-2}	S	SAMPLE	ΔP_{t-i} LAGS	ΔQ_{t-i} LAGS	β_1 β_2	T VALUE
LCCLONFP	LCCLONFV	16	ALL	0	1	0.0022	1.848
LCCNYFP	LCCNYFV	5	ALL	2	0	0.0022	0.481
LCCLONFP	LCCLONFV	1	ALL	5	0	0.0025	0.581
LCCNYFP	LCCLONFV	11	ALL	2	1	0.0032	2.378*
LCELONFP	LCELONFV	2	ALL	2	0	-0.0012	-1.123
LCFNYFP	LCFNYFV	18	1992	0	0	0.0097	1.189
LCFLONFP	LCFNYFV	23	1992	1	1	0.0052	1.052
LCFNYFP	LCFLONFV	8	ALL	2	0	0.0007	0.348
LSULONFP	LSULONFV	2	ALL	1	0	0.0016	2.022*
LSUNYFP	LSUNYFV	1	ALL	0	0	0.0045	2.174*
LSULONFP	LSUNYFV	2	ALL	1	0	0.0016	0.777
LSUNYFP	LSULONFV	2	ALL	2	0	0.0128	1.818
LCPNYFP	LCPNYFV	1	ALL	2	1	.0014	0.257
LCPLONFP	LCPLONFV	1	ALL	2	0	0.0037	1.162
LCPNYFP	LCPNYFV	1	ALL	0	0	0.0097	2.076*
LCPLONFP	LCPNYFV	1	ALL	1	1	0.0069	2.482*
LCPNYFP	LCPLONFV	11	1993	1	1	0.0051	0.562
LMRKKFP	LMRKKFV	1	ALL	0	1	0.1118	0.360

** and ** indicate significance at 95% and 99% levels of significance respectively.*

Table II.5b : Results of tests of parameter constancy in ECMs over observations for 27/01/95 - 28/02/95.

$P_{...}$	$Q_{...}$	Forecast Chi'	Chow F
LCCLONFP	LCCLONFV	6.522	0.296
LCCNYFP	LCCNYFV	8.965	0.406
LCCLONFP	LCCNYFV	6.079	0.276
LCCNYFP	LCCLONFV	9.628	0.437
LCFLONFP	LCFLONFV	11.942	0.541
LCFNYFP	LCFNYFV	12.159	0.549
LCFLONFP	LCFNYFV	11.557	0.521
LCFNYFP	LCFLONFV	13.605	0.618
LSULONFP	LSULONFV	10.717	0.486
LSUNYFP	LSUNYFV	10.842	0.492
LSULONFP	LSUNYFV	11.005	0.499
LSUNYFP	LSULONFV	9.829	0.447
LCTNYFP	LCTNYFV	24.868	1.121
LCPLONFP	LCPLONFV	25.539	1.061
LCPNYFP	LCPNYFV	24.362	1.105
LCPLONFP	LCPNYFV	24.015	1.087
LCPNYFP	LCPLONFV	18.963	0.857
LMRBKOFP	LMRBKOFV	2.154	0.913

Table II.6 : Changes in the futures to physical ratio 1992-1994

F/P RATIO	AVERAGE OVER YEAR UP TO FEB 1992	AVERAGE OVER YEAR UP TO DEC 1992	AVERAGE OVER YEAR UP TO DEC 1993	AVERAGE OVER YEAR UP TO DEC 1994	MEAN OVER WHOLE SAMPLE
CCUKRATIO	16.66	15.49	17.81	---	16.93
CCUSRATIO	31.10	38.11	52.09	---	42.74
CFUKRATIO	1.39	4.61	4.75	4.37	3.75
CFUSRATIO	26.04	27.05	37.63	48.17	35.23
SUUSRATIO	153.78	95.91	134.47	183.75	143.30
RBJRATIO1	8.73	6.13	10.43	22.42	12.23
RBJRATIO2	8.50	5.82	10.20	22.63	12.05
CTUSRATIO	10.56	11.02	10.74	12.67	11.39
CPUKRATIO	30.87	28.43	56.53	55.08	43.62
CPUSRAT'1	0.44	0.42	0.50	0.56	0.49
CPUSRAT'2	3.26	3.18	3.34	3.26	3.31

Table II.7 : Integration tests

Variable : Y	ADF-stat. for Y	ADF-stat. for ΔY
CCUSRATIO	-0.172	-5.352**
CCUKRATIO	0.597	-4.952**
CCLNFPI	-0.789	-3.791**
CCNYFPI	-0.685	-3.926**
CFUSRATIO	-1.038	-8.128**
CFUKRATIO	-0.845	-32.406**
CFNYFPI	-1.589	-6.358**
CFLNFPI	-1.589	-7.177**
SUUSRATIO	-0.212	-9.439**
SUNYFPI	-2.104	-7.286**
RBJRATIO1	1.023	-13.184**
RBJRATIO2	1.836	-11.252**
RBNYCPI	0.000	-6.503**
CTUSRATIO	-0.249	-7.916**
CTNYFPI	-0.735	-7.360**
CPUKRATIO	-0.063	-8.502**
CPUSRATIO1	0.338	-9.358**
CPUSRATIO2	0.212	-10.722**
CPLNFPI	-0.282	-8.907**
CPNYFPI	-0.095	-8.316**

Critical values as for table II.1.

Table II.8 : Cointegration tests

COMMODITY			ADF-stat.	coeff.	std. error
COCOA	CCLNFPI	CCUKRATIO	-3.090 +	0.131	0.021
	CCNYFPI	CCUSRATIO	-4.553**	0.070	0.006
COFFEE	CFNYFPI	CFUSRATIO	-4.209**	0.113	0.009
	CFLNFPI	CFUKRATIO	-3.741*	0.098	0.094
SUGAR	SUNYFPI	SUUSRATIO	-6.032**	0.018	0.003
RUBBER	RBNYCPI	RBJRATIO1	-5.599**	0.079	0.009
	RBNYCPI	RBJRATIO2	-4.444**	0.081	0.008
COTTON	CTNYFPI	CTUSRATIO	-7.783**	0.231	0.013
COPPER	CPLNFPI	CPUKRATIO	-6.477**	0.040	0.003
	CPNYFPI	CPUSRATIO1	-6.669**	4.219	0.277
	CPNYFPI	CPUSRATIO2	-5.493**	0.611	0.043

Critical values as for table II.2.

Table II.9 : Causality tests between price instability and the futures to physical ratio

COMMODITY	PI	SP	F: SP → PI	F: PI → SP
COCOA	CCLNFPI	CCUKRATIO	16.013** (2,6)	5.062 (2,6)
	CCNYFPI	CCUSRATIO	6.643* (1,6)	7.625* (1,6)
COFFEE	CFCNYFPI	CFUSRATIO	21.996** (1,43)	0.997 (1,43)
	CFLNFPI	CFUKRATIO	4.018* (1,42)	29.677** (1,42)
SUGAR	SUNYFPI	SUUSRATIO	5.378* (1,43)	2.152 (1,43)
RUBBER	RBNYCPI	RBJRATIO1	10.777** (1,43)	3.101 (1,43)
	RBNYCPI	RBJRATIO2	12.124** (1,43)	1.521 (1,43)
COTTON	CTNYFPI	CTUSRATIO	29.445** (1,45)	3.383 (1,45)
COPPER	CPLNFPI	CPUKRATIO	25.700** (1,45)	2.348 (1,45)
	CPNYFPI	CPUSRATIO1	24.762** (1,45)	0.009 (1,45)
	CPNYFPI	CPUSRATIO2	10.725** (1,45)	0.006 (1,45)

*** and * represent significant causality at 99% and 95% levels respectively.*

TABLE II.10 : Correlations of daily log changes in commodity prices in London

	COCOA	COFFEE	SUGAR	COPPER	RUBBER
COCOA	1.000				
COFFEE	0.243	1.000			
SUGAR	0.255	0.349	1.000		
COPPER	0.329	0.403	0.449	1.000	
RUBBER	0.092	0.038	0.076	0.089	1.000

$\chi^2_{(10)}=263.307$

Table II.11 : Correlations of daily log changes in commodity prices in New York

	COCOA	COFFEE	SUGAR	COTTON	COPPER	RUBBER
COCOA	1.000					
COFFEE	0.186	1.000				
SUGAR	0.066	0.012	1.000			
COTTON	0.109	0.000	0.028	1.000		
COPPER	0.021	0.049	0.037	0.019	1.000	
RUBBER	-0.013	-0.040	-0.036	0.004	-0.020	1.000

$\chi^2_{(15)}=60.041$

Table II.12 : Test statistics for hypothesis of excess co-movement between commodity prices

	Specification 1	Specification 2
London	$\chi^2_{(15)}=31.139$	$\chi^2_{(10)}=33.096$
New York	$\chi^2_{(15)}=55.852$	$\chi^2_{(15)}=61.406$

Table II.13 : Results of regression of prices on stocks

PRICE	STOCKS	COEFFICIENT	T-STATISTIC
LSGLNFP	ΔLSGECTSX	-0.111	-2.076*
LRBNYCP	LRBUSSTX(-1)	-0.244	-4.233**
LRBLNCP	LRBTCSTX(-1)	-0.221	-7.503**
LCTNYFP	ΔLCTUSSTX	-0.139	-2.102*
LCPLNFP	LCPUKSTX	-0.055	-3.150**
LCPNYFP	LCPUSSTX	-0.178	-7.018**

** and ** indicate significance at a 95% and 99% level of significance respectively.*

Table II.14 : Integration tests

Variable : Y	ADF-stat. for Y	ADF-stat. for ΔY
SGECSTX	-0.751	-4.710**
SGLNFPI	-1.920	-7.395**
RBUSSTX	-1.085	-7.694**
RBTCSTX	-1.024	-5.643**
RBNYCPI	0.000	-6.503**
CTUSSTX	-0.797	-4.829**
CTNYFPI	-0.735	-7.360**
CPUKSTX	-1.495	-3.132*
CPUSSTX	-0.731	-4.996**
CPLNFPI	-0.282	-8.907**
CPNYFPI	-0.095	-8.316**

***, and * indicate rejection of H_0:I(1) at a 99% and 95% level of significance respectively.*

Table II.15 : Cointegration tests

		sample	ADF-stat	coeff.	s.e.
SGLNFPI	SGECSTX	ALL	-4.465**	-0.1x10^{5}	0.7x10^{4}
RBNYCPI	RBUSSTX	ALL	-4.891**	-0.020	0.005
CTNYFPI	CTUSSTX	ALL	-7.871**	-0.00001	0.00004
CPLNFPI	CPUKSTX	ALL	-5.975**	0.012	0.005
CPNYFPI	CPUSSTX	ALL	-6.073**	0.006	0.005

** and ** indicate acceptance of cointegration at 95% and 99% levels of significance respectively.*

Table II.16 : Causality tests between price instability and stock levels

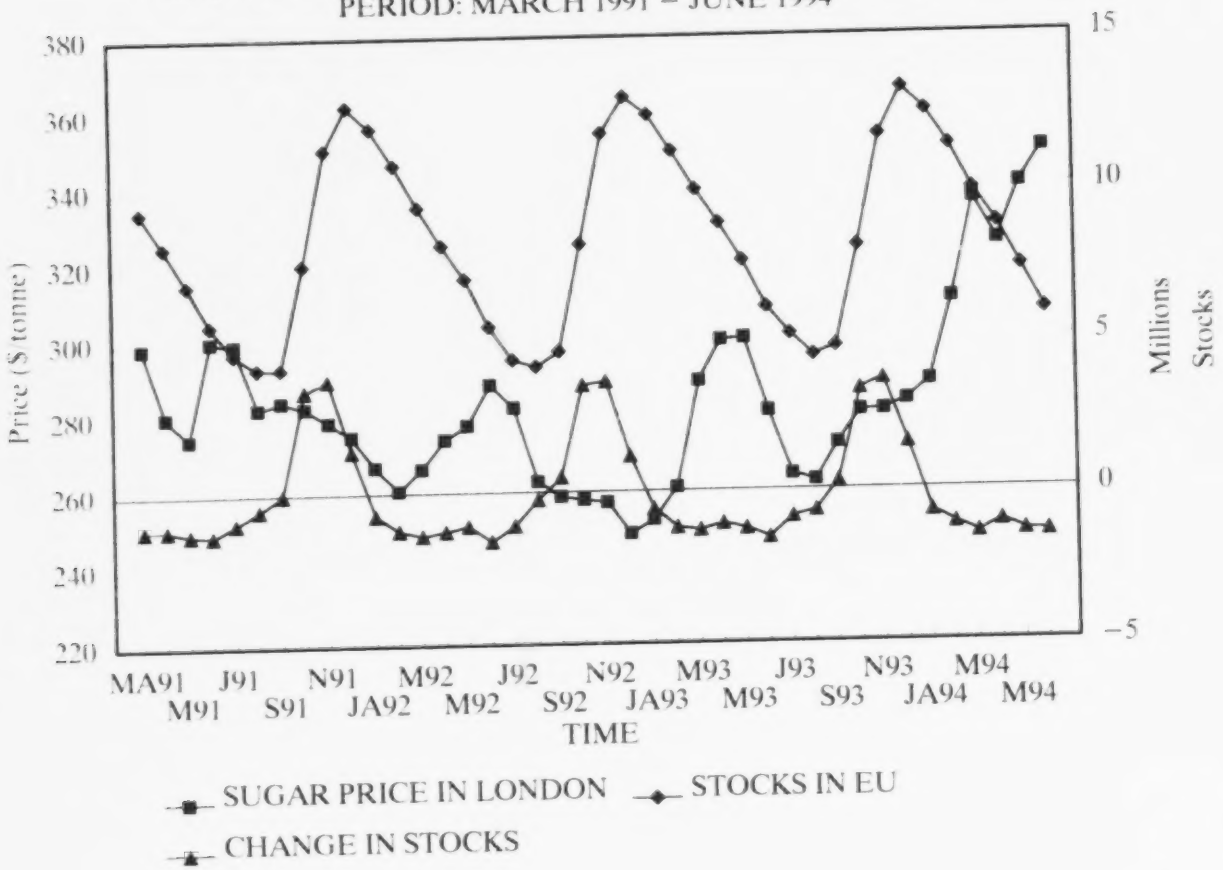
PI	ST	sample	F : ST→PI	F : PI→ST
SGLNFPI	SGECSTX	ALL	9.736** (1,37)	0.956 (1,37)
RBNYCPI	RBUSSTX	ALL	4.289** (1,42)	0.327 (1,42)
CTNYFPI	CTUSSTX	ALL	12.660** (1,45)	0.586 (1,45)
CPLNFPI	CPUKSTX	ALL	9.182** (1,45)	0.002 (1,45)
CPNYFPI	CPUSSTX	ALL	10.530** (1,45)	0.076 (1,45)

*** indicates significant causality at the 99% level of significance.*

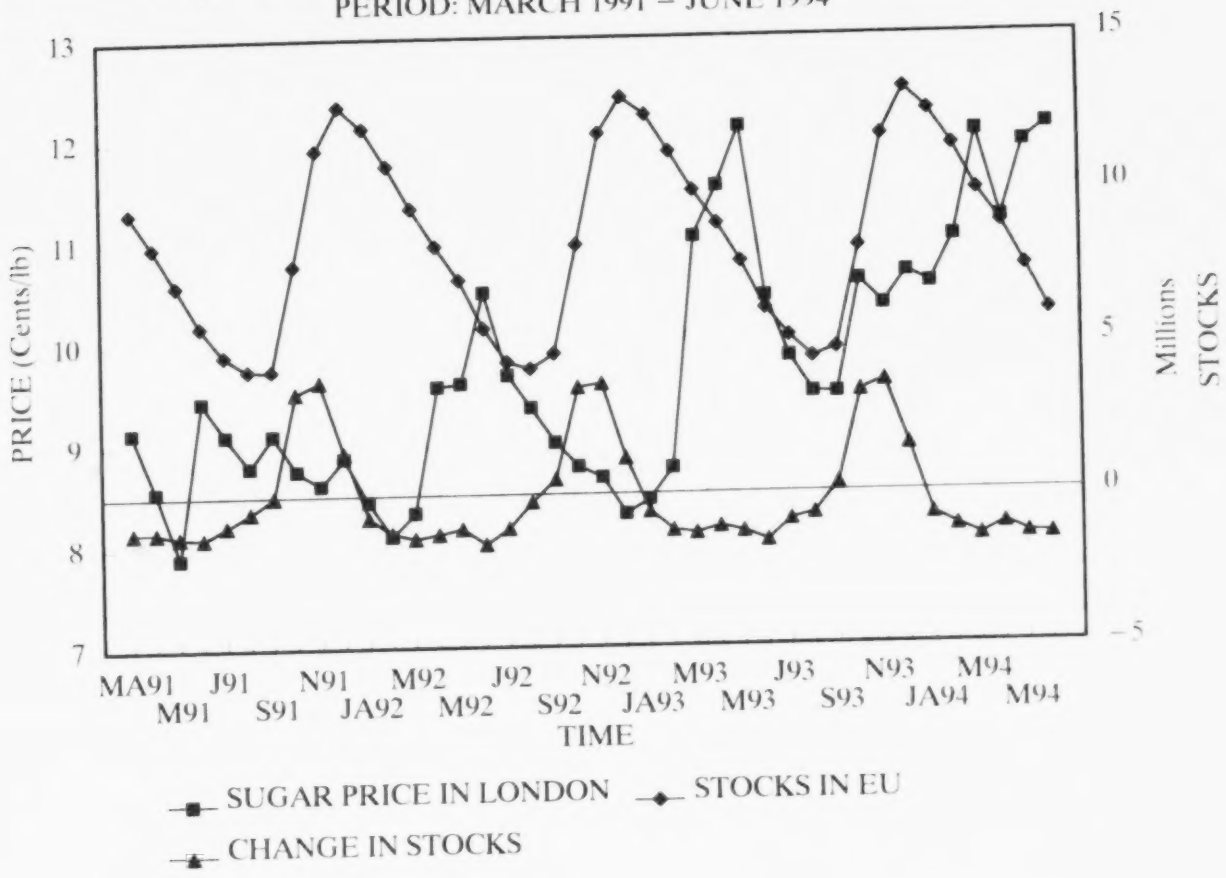
Table II.17 : The importance of commodities in LDC exports

COMMODITY	COUNTRY	VALUE OF EXPORTS $000 1989-90	% OF COUNTRY'S EXPORTS 1989-90	% OF WORLD EXPORTS 1989-90	PRICE INSTAB. (C.V.)
COCOA	GHANA COTE D'IVOIRE	418473 978998	39.40 34.61	10.26 24.01	0.20(LON) 0.15(NY)
COFFEE	KENYA COSTA RICA	201420 265936	19.28 18.40	2.12 2.79	0.65(LON) 0.48(NY)
SUGAR	DOMINICAN REP. GUYANA	187850 78854	22.66 32.69	1.47 0.62	0.14(LON) 0.18(NY)
RUBBER	MALAYSIA INDONESIA	1291625 930754	4.73 3.90	28.12 20.84	0.25(LON) 0.23(NY)
COTTON	PAKISTAN PARAGUAY	596571 317573	11.67 32.27	6.87 3.66	0.17(NY)
COPPER	CHILE ZAMBIA	3299959 1083127	39.49 81.56	14.53 4.77	0.14(LON) 0.15(NY)

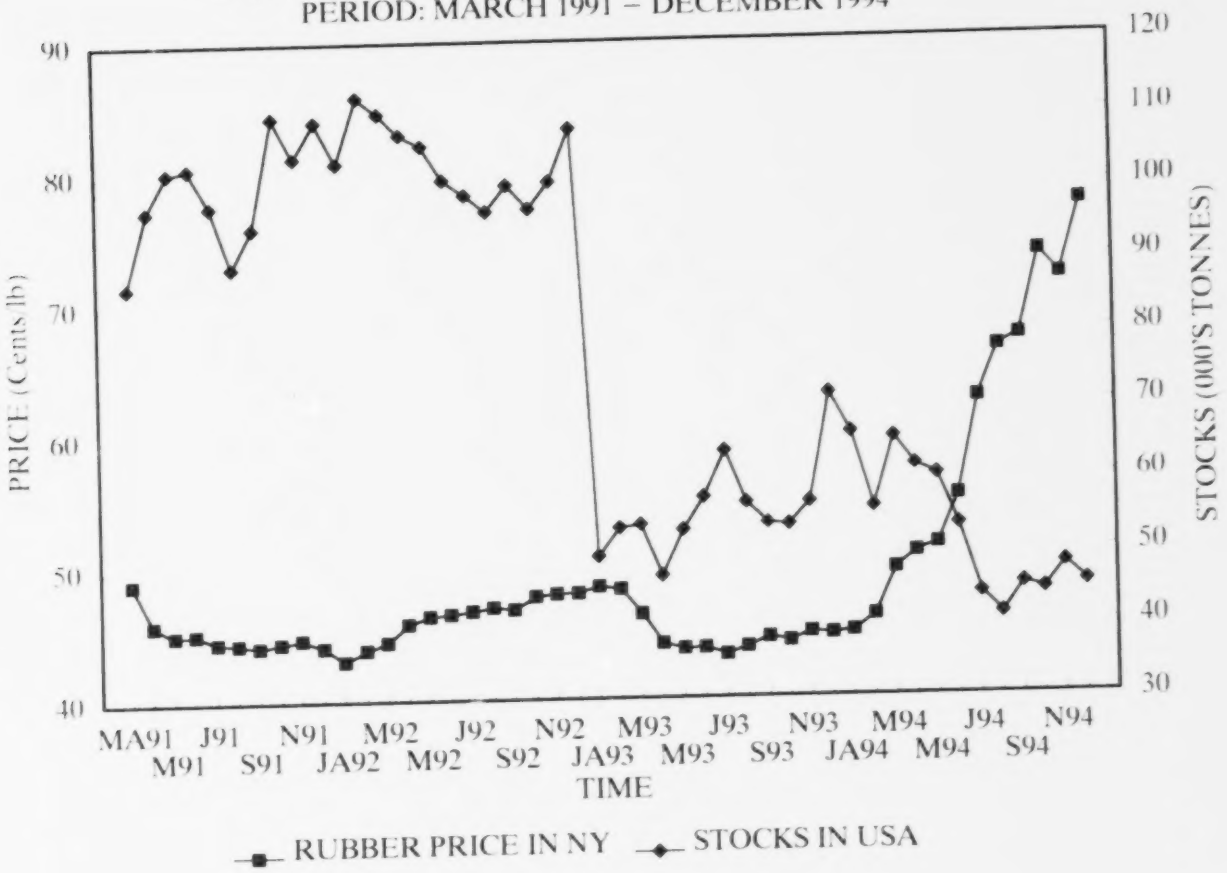
Graph 1.a: MONTHLY SUGAR PRICE IN UK AND STOCKS IN EU
PERIOD: MARCH 1991 – JUNE 1994



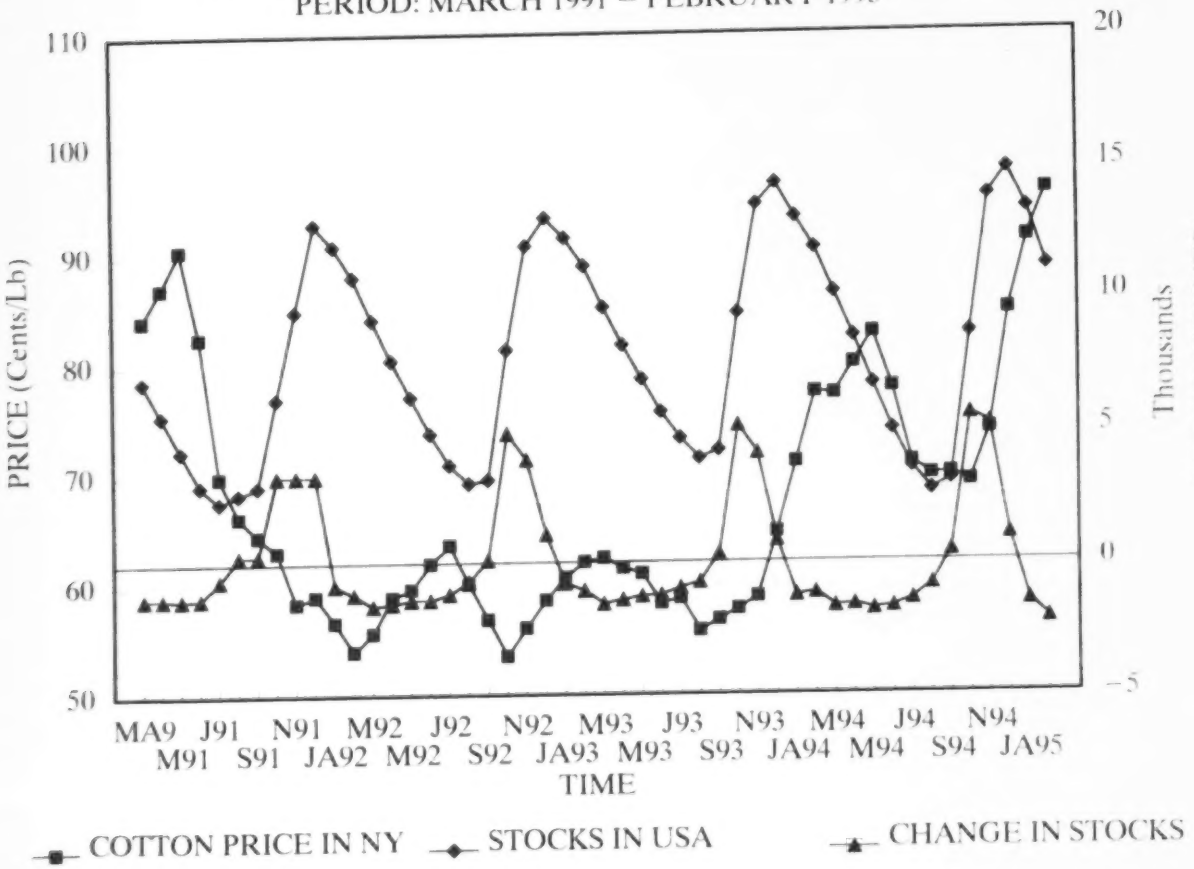
Graph 1.b: MONTHLY SUGAR PRICE IN USA AND STOCKS IN EU
PERIOD: MARCH 1991 – JUNE 1994



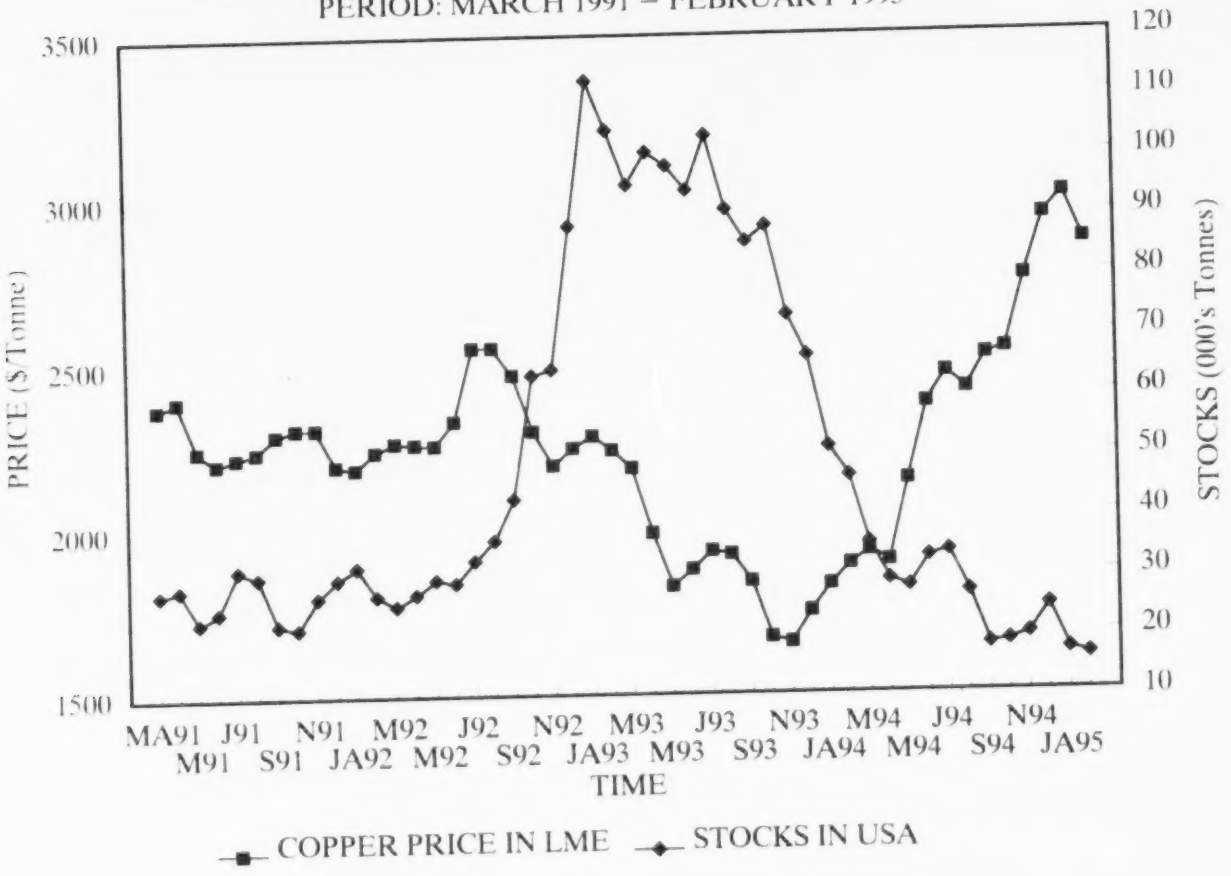
Graph 2: MONTHLY RUBBER PRICE AND STOCKS IN USA
PERIOD: MARCH 1991 – DECEMBER 1994



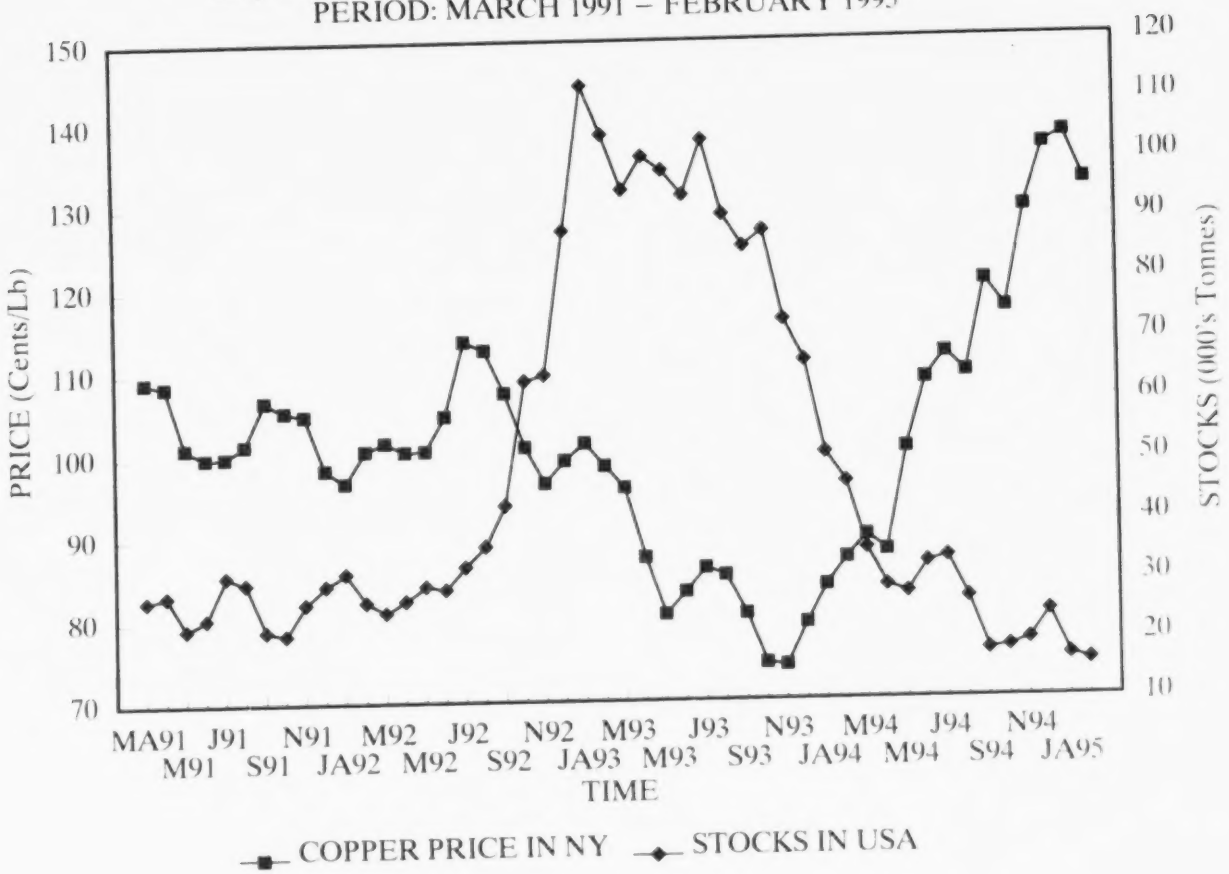
Graph 3: MONTLY COTTON PRICE AND STOCKS IN USA
PERIOD: MARCH 1991 – FEBRUARY 1995



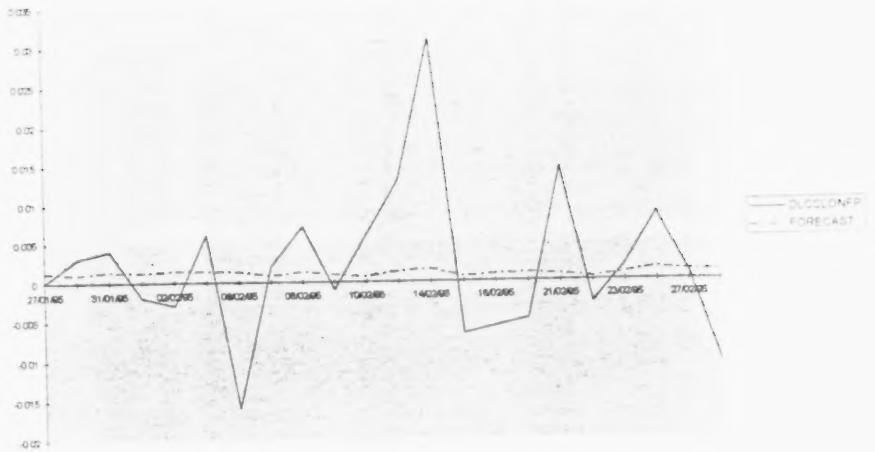
Graph 4.a: MONTHLY COPPER PRICE UK AND STOCKS IN USA
PERIOD: MARCH 1991 – FEBRUARY 1995



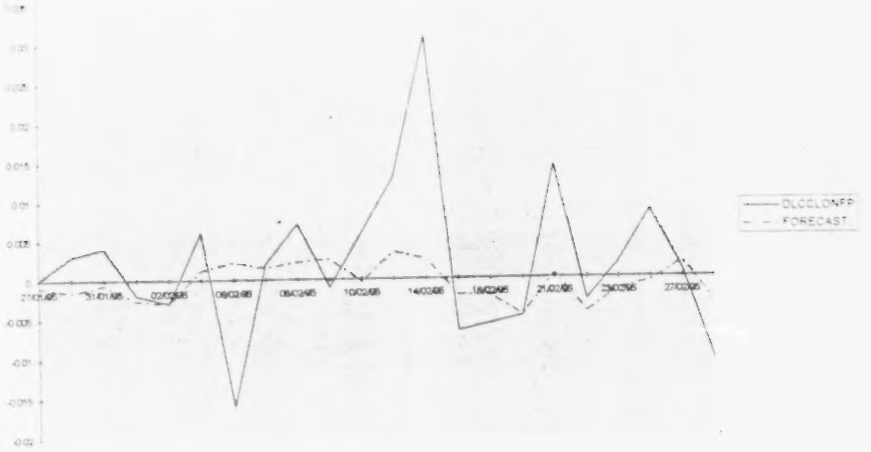
Graph 4.b: MONTHLY COPPER PRICE AND STOCKS IN USA
PERIOD: MARCH 1991 – FEBRUARY 1995



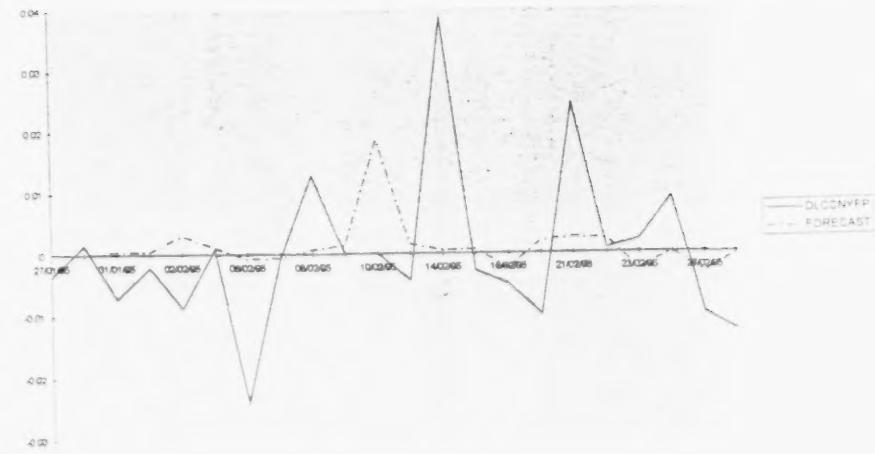
First difference of logged London cocoa nearest future price : actual and as forecast by first difference of logged London cocoa nearest future volume, 27/01/95 - 28/02/95



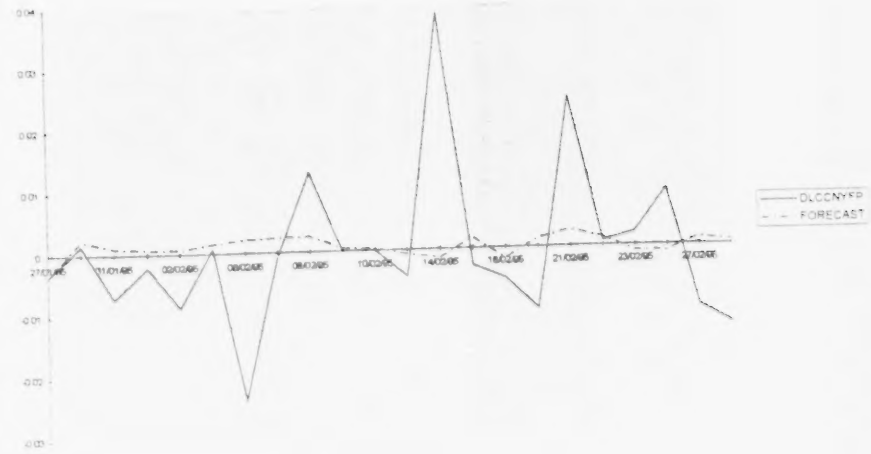
First difference of logged London cocoa nearest future price : actual and as forecast by first difference of logged New York cocoa nearest future volume, 27/01/95 - 28/02/95



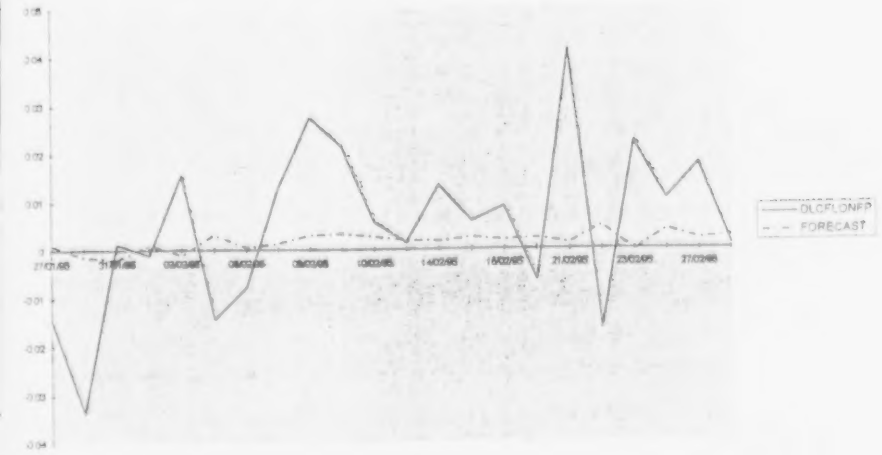
First difference of logged New York cocoa nearest future price : actual and as forecast by first difference of logged New York cocoa nearest future volume, 27/01/95 - 28/02/95



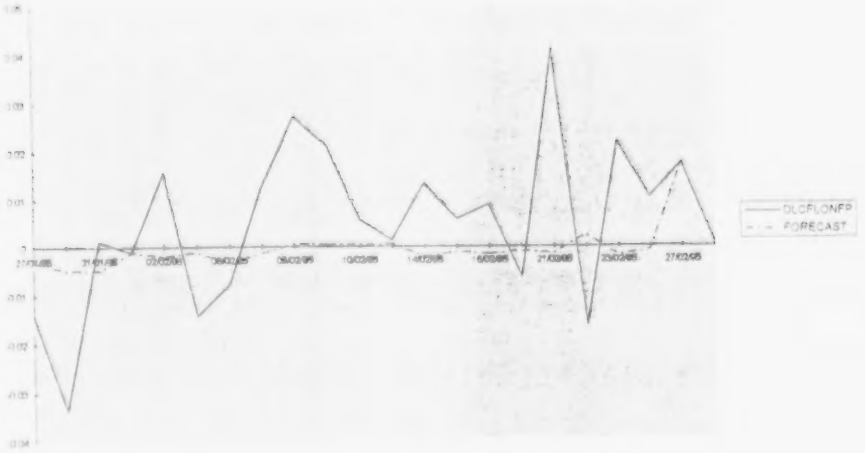
First difference of logged New York cocoa nearest future price : actual and as forecast by first difference of London cocoa nearest future volume, 27/10/95 - 28/02/95



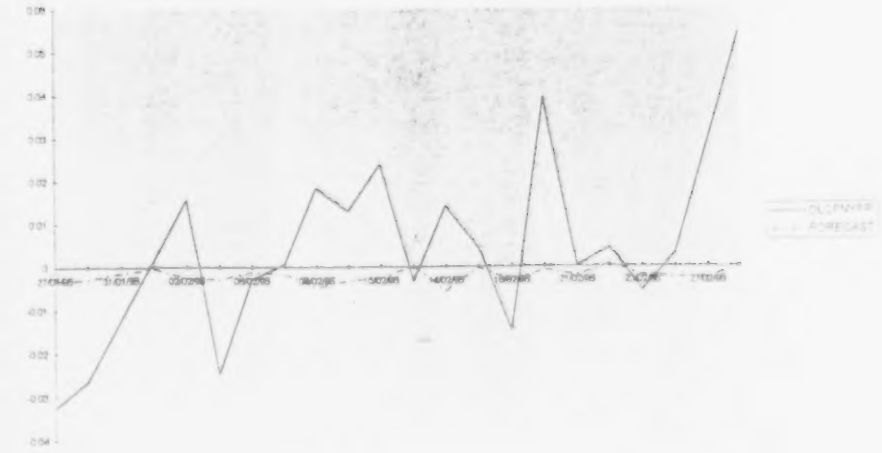
First difference of logged London coffee nearest future price : actual and as forecast by first difference of logged London coffee nearest future volume, 27/01/95 - 28/02/95.



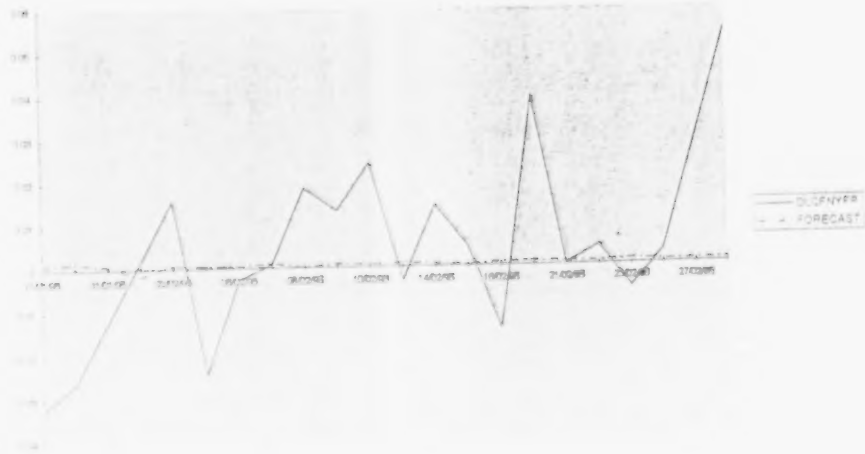
First difference of logged London coffee nearest future price : actual and as forecast by first difference of logged New York coffee nearest future volume, 27/01/95 - 28/02/95.



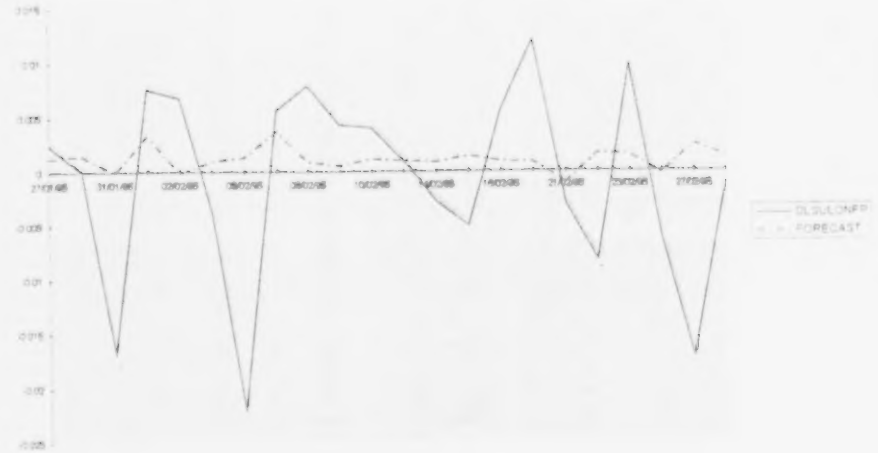
First difference of logged New York coffee nearest future price : actual and as forecast by first difference of logged New York coffee nearest future volume, 27/01/95 - 28/02/95.



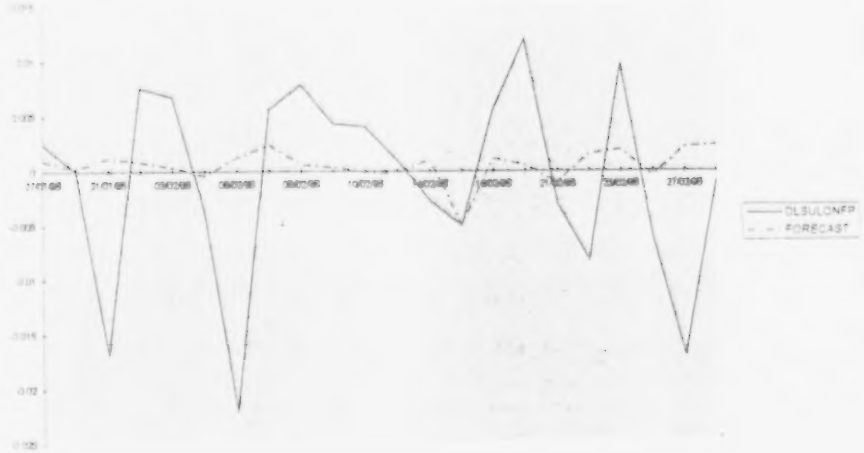
First difference of logged New York coffee nearest future price : actual and as forecast by first difference of logged London coffee nearest future volume, 27/01/95 - 28/02/95.



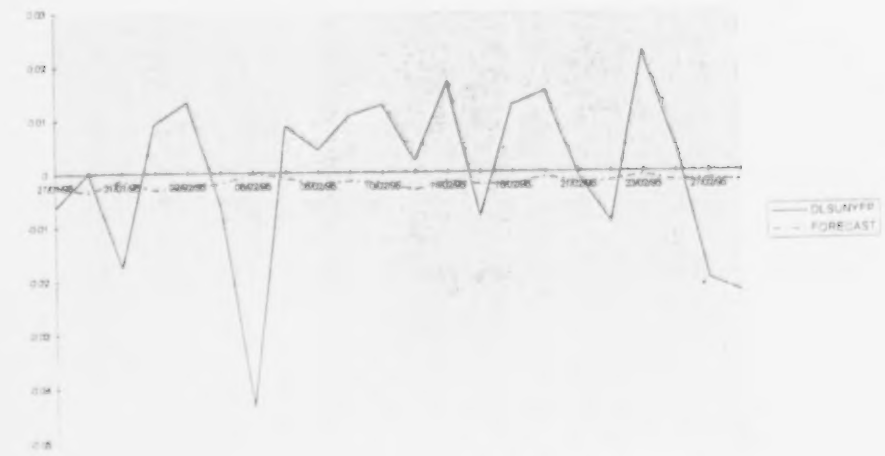
First difference of logged London sugar nearest future price - actual and as forecast by first difference of logged London sugar nearest future volume, 27/01/95 - 28/02/95.



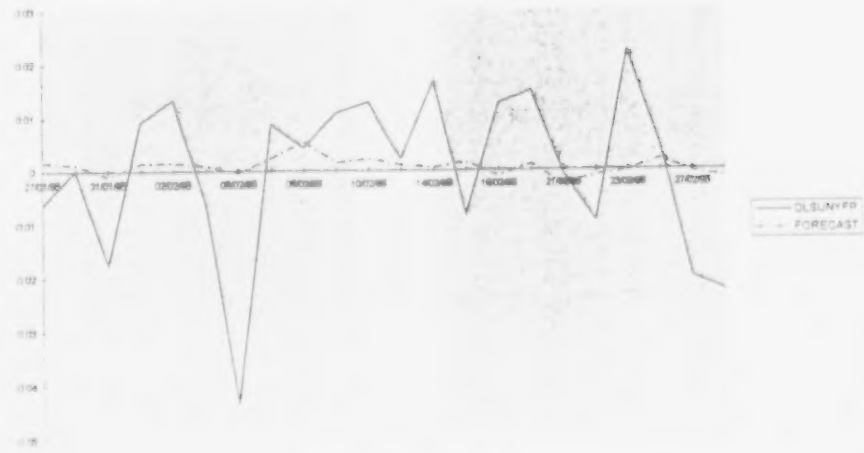
First difference of logged London sugar nearest future price - actual and as forecast by first difference of logged New York sugar nearest future volume, 27/01/95 - 28/02/95.



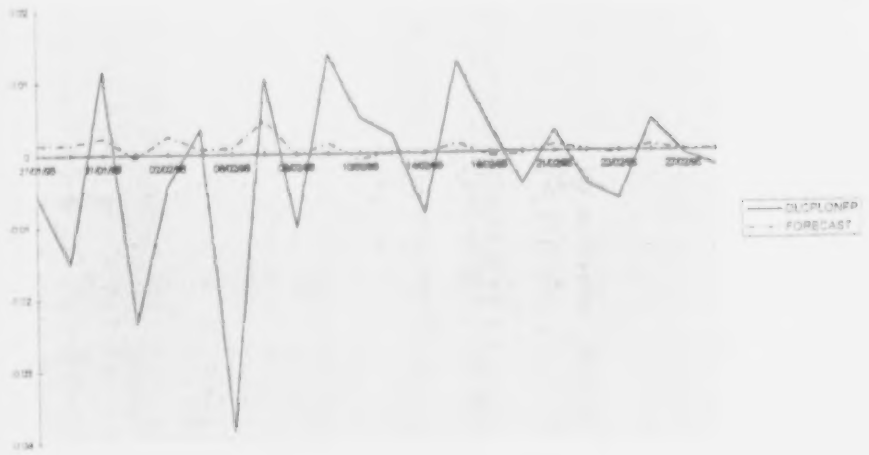
First difference of logged New York sugar nearest future price - actual and as forecast by first difference of logged New York sugar nearest future volume, 27/01/95 - 28/02/95.



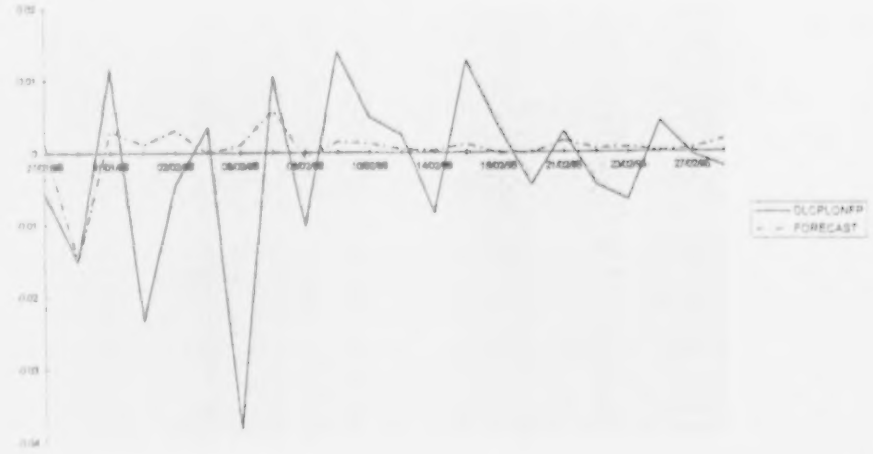
First difference of logged New York sugar nearest future price - actual and as forecast by first difference of logged London sugar nearest future volume, 27/01/95- 28/02/95.



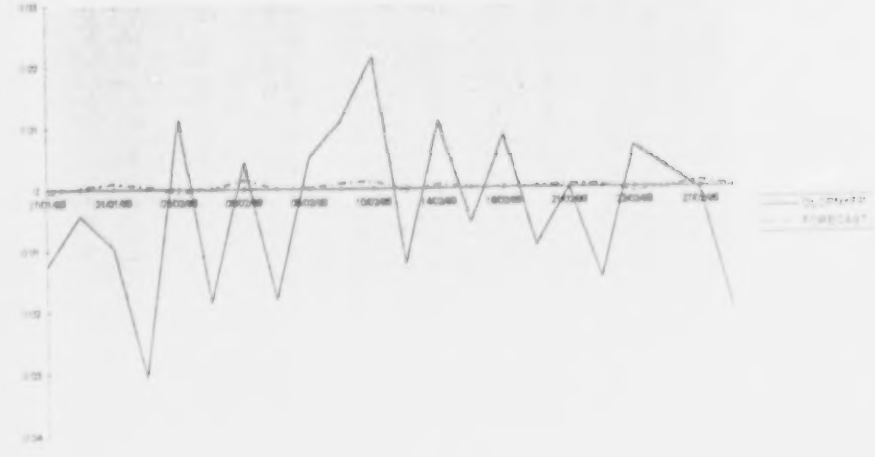
First difference of logged London copper nearest future price : actual and as forecast by first difference of logged London copper nearest future volume, 27/01/95 - 28/02/95.



First difference of logged London copper nearest future price : actual and as forecast by first difference of logged New York copper nearest future volume, 27/01/95 - 28/02/95.



First difference of logged New York copper nearest future price : actual and as forecast by first difference of logged New York copper nearest future volume, 27/01/95 - 28/02/95.



First difference of logged New York copper nearest future price : actual and as forecast by first difference of logged London copper nearest future volume, 27/01/95 - 28/02/95.

First difference of logged New York cotton nearest future price : actual and as forecast by first difference of logged New York cotton nearest future volume, 27/01/95 - 28/02/95